Spring 2010

Bulletin of the Massachusetts Archaeological Society, Vol. 71, No. 1

Massachusetts Archaeological Society

BULLETIN OF THE

MASSACHUSETTS ARCHAEOLOGICAL SOCIETY

VOLUME 71 (1) SPRING 2010

Special Issue: Sacred Landscapes and Skyscapes

CONTENTS:

THE MASSACHUSETTS ARCHAEOLOGICAL SOCIETY, Inc.
P. O. Box 700, Middleborough, Massachusetts 02346-0700

THE MASSACHUSETTS ARCHAEOLOGICAL SOCIETY, Inc.
Robbins Museum of Archaeology
Web Site address: www.massarchaeology.org
phone: (508) 947-9005
email: info@massarchaeology.org

The *BULLETIN OF THE MASSACHUSETTS ARCHAEOLOGICAL SOCIETY* is published semi-annually, with a Spring issue, Number 1, and a Fall issue, Number 2. Individual memberships in the Society that include receiving the *Bulletin* are $30. For information on institutional subscriptions and other special rates for membership, as well as requests for back issues of the *Bulletin*, please visit the web site or contact the Massachusetts Archaeological Society, P.O. Box 700, Middleborough, MA 02346 (508-947-9005). Publication in the *Bulletin* is a privilege of membership. Manuscripts and comments may be sent to the editor, Curtiss Hoffman, 58 Hilldale Road, Ashland, MA 01721 or emailed to c1hoffman@bridgew.edu.

Printed by DigiPrint, P.O. Box 1281, Lakeville MA 02347

Editor's Note

Welcome to the Spring 2010 issue of the *Bulletin of the Massachusetts Archaeological Society*! I am pleased to report that, with the guidance of the Board of Trustees, a new policy has been adopted for the editing of the Bulletin: henceforth, complete galley proof copy (rather than drafts) was sent to our two very able proofreaders, Kathy Fairbanks and Bill Moody, and also to the authors, to ensure that overprints and other errors which crept into the galleys in the past two issues were headed off at the pass.

In my first editorial comments last Spring (Hoffman 2009:1), I stated that, "from time to time I am prepared to include articles which explore controversial subjects, so long as the authors argue their perspectives clearly and base them firmly upon the evidence." The three articles in the current issue are of this nature, in that they all explore the connections between certain large-scale features of the built environment and possible astronomical alignments. The authors have embedded their discussions within a framework of careful observation and measurement, as well as reference to historic and ethnographic materials, both local and from further afield. To prepare readers for this material, I feel that it is important to place the debate within some context, and this necessitates a rather longer set of editorial comments than is usual for this journal.

The sacred is a dimension of pre-European Native culture which has been relatively little explored by New England archaeologists until recently. However, a unique set of circumstances has recently emerged, including increasing threats to previously protected sacred sites, the emergence of a strong Native voice in archaeological affairs, and the development of a deeper understanding of non-European belief systems among anthropologists and archaeologists in the region. As a result of these factors, some Native elders are coming forward with information which they claim that they have previously kept secret. They are expressing their concerns about the threat to sacred sites and objects, their determination to make use of Federal laws protecting their religious freedom to preserve these sites, and a measure of optimism that at least some members of the archaeological community will be receptive to their perspectives on this vital issue. This presents archaeologists in this region with an unprecedented opportunity to explore the sacred dimensions of Native culture which, as we now are coming to understand it, have for countless centuries underlain and conditioned all other aspects of their culture.

Over the past 150 years, much antiquarian interest in New England has focused upon stone chambers, stone rows, cairns, stone piles, and other stone constructions. This subject has been fraught with controversy throughout the history of New England archaeology. Early antiquarian investigators tended to invent fanciful explanations for these constructions (Feder 1999:79-132), often involving the diffusion of pre-Columbian European (e.g., Goodwin 1946) – or, occasionally, Phoenician (Gordon 1971), North African (Totten 1998) or even Chinese (Cyr 1998) – explorers, and they sometimes liberally reconstructed the sites to match their theories. These investigators were often untrained in academic archaeology, conducted unsystematic excavations, and tended to adopt and perpetuate theories of the racial superiority of Europeans which were antiquated even in their day (Willey and Sabloff 1974:28-40), as a further justification of the doctrine of *vacuum domicilis* which was used by European colonists to justify their appropriation of lands in the New World.

For these reasons, most of the small community of professional archaeologists in the region during the mid-20th century adopted a determinedly negative attitude, not only towards the amateur researchers, but also towards the objects of their research. Stone walls, stone piles, stone chambers, and the like were simply not considered appropriate subjects of investigation – they were all assumed without question by professional archaeologists to be constructions related to post-Contact Euro-American agricultural activities. Since these professionals also were responsible for the training of the next two generations of archaeologists in the region, these negative attitudes have tended to endure in some quarters of the region's academically trained archaeological community, even to the present.

Nevertheless, the antiquarian investigators persisted, and by 1964 they had organized their own non-profit organization, the New England Antiquities Research Association (NEARA), dedicated to the documentation of stone structures in the region. NEARA fairly early on adopted a policy of not engaging in sub-surface excavation, but it still continued to entertain wildly speculative theories on the origins, age, and cultural affiliation of the structures (Carlson 2004).

With the publication of Barry Fell's enormously popular book *America, B.C.* in 1976, there was a revival of antiquarian interest in trans-Atlantic diffusion, resulting in a conference at Castleton State College in Vermont in 1977, which brought together both supporters and opponents of diffusionist hypotheses. Some of the papers presented at the conference, and subsequently published in an edited volume (Cook 1978), were the first to propose systematic methods of investigating stone structures. Among the presenters was Giovanna Neudorffer (now Peebles), the Vermont State Archaeologist, who conducted a survey of stone chambers in Vermont, using both documentary sources and field investigation (1978). She demonstrated that there is a statistically demonstrable correlation between the locations of chambers and those of 18th century farmsteads, which she interpreted as causal: that the structures were constructed as adjuncts to the farmsteads.

In a similar vein, John Cole, of the Anthropology Department at the University of Massachusetts at Amherst, conducted a field school in 1979 using an explicitly scientific methodology, asking students to formulate multiple research hypotheses about the so-called "Monks Caves" in western Massachusetts, and then to perform field tests on them to determine which of the hypotheses was most likely to be correct. He concluded that there was no evidence for pre-European construction, and he castigated those who persisted in maintaining diffusionist hypotheses as being guilty of "cult archaeology" – though he acknowledged that he had little expectation that his study would gain many converts from their ranks (Cole 1982:55).

Cole and Neudorffer's studies certainly satisfied the growing professional archaeological community that stone construction was the exclusive province of Euro-American farmers. This became the prevailing attitude at most State Historic Preservation Offices, often with negative consequences for site preservation, as development continued to encroach into the upland areas of the region where many of these structures are located. This belief is still strongly held in some quarters locally, despite the fact that stone structures of indisputably Native stone construction are now known from most other parts of the North American continent.

The first hint that it might not be true in all cases that New England Native peoples never built in stone came in 1982, when members of the Institute for Conservation Archaeology excavated a dry-laid stone wall at the drip line of the Flagg Swamp Rockshelter in Marlboro, Massachusetts (Huntington 1982:16-17; Blancke and Spiess 2006:4). This site was unquestionably exclusively Native American in construction, and the wall was reliably dated to the Late Archaic phase on the basis of stratigraphy and associated artifacts. Excavations at this location also uncovered a complete bear skull, with its mandible placed upon the top of the cranium, which the excavators understood to be a ritual placement of an animal well-known to be important in Native thought (Volmar 1996).

Throughout the 1980's, opinions in NEARA and other such groups began to shift from exclusively diffusionist ideas to an alternative hypothesis: that the stone constructions they studied could be Native in origin. Mavor and Dix's popular book *Manitou: The Sacred Landscape of New England's Native Civilization* (1989) combined field research, historical documentation, and ethnographic investigation. They concluded that many of these sites were not only affiliated with documented Native religious practices, they were part of a system of archaeoastronomical observation which linked these practices to the cycles in the heavens. A growing number of radiocarbon dates on stone pile structures and complexes places most of them no earlier than the 12th century B.P. (Whittall 1989), which is just around the time that maize-bean-squash horticulture began to be adopted in the region Elsewhere in the world, most stone or earthen structures with archaeoastronomical alignments begin to appear contemporary

with the introduction of surplus agriculture (Clark 1977:479), for the logical reason that planting and harvesting require a more precise knowledge of the annual cycle do than hunting and gathering. Despite this correlation, this type of research has met with skepticism or outright scorn from conservatives in the local professional community (e.g., Dincauze 1982, Leveillee 1997). Ballard and Mavor explore some of the intellectual roots of this skepticism in their contribution to this issue.

The recent introduction of Native voices into the debate about sacred stones has been a fundamentally game-changing transformation. Until fairly recently, most archaeologists in the Northeast have felt that there was nothing to be gained from consulting with the remnants of Native groups who survived the impact of colonization, and that, when excavation provided insufficient evidence, they had to rely instead upon scanty accounts of the Colonists' written observations of Native beliefs and practices. Some acknowledged that these may or may not have been representative samples, and that they were furthermore passed through the distorting cultural screen of the colonists' expectations about Natives.

This view unnecessarily privileges the written narratives over other forms of history – in fact, the term "prehistory", widely used until recently by many archaeologists to define pre-Contact cultures, has similar pejorative connotations with regard to oral traditions. We now have the opportunity to contact and exchange ideas with a more direct source of information. Native elders (e.g. Seketau 2003) inform us that they have always known about their sacred sites, but that they have felt that this knowledge needed to be kept within the tribe. They justifiably felt (and, according to Doug Harris (2004) some still do feel) that to release information about these sites would inevitably lead to their desecration and destruction. While some elders are now willing to inform us about which locations are sacred sites, they are usually not prepared to explain how and why they are sacred or what they were used for – this is still considered to be the prerogative of the tribe, to be retained for the benefit of its members only. The Federally recognized tribes east of the Mississippi, banded together as the United South and Eastern Tribes organization, have issued two official resolutions concerning the importance of sacred sites and the need to partner with local towns and cities to assist in their preservation (USET 2003) and to work with Federal authorities to secure preservaton of these sites. The text of the second of these resolutions is reproduced in the Appendix below.

This development has not come easily to archaeologists, either professional or amateur. Most American archaeologists who entered the profession since the mid-1960s have been trained to regard the material evidence of subsistence pursuits as primary, and the evidence of ideology to be of only secondary or even tertiary importance (e.g. Binford 1965). As a result, archaeologists may very well have overlooked many of the larger stone constructions that were part of Native ritual practice. However, there is now a major paradigm shift underway in archaeology, which is leading archaeologists to reevaluate traditional belief systems as valid for the cultures who have held them, even if they are not shared or even understood by the archaeologist (e.g., Carmichael et al. 1994; Clottes and Lewis-Williams 1996; Hall 1997; Price 2001; Pearson 2002; McNiven and Russell 2005).

The interests of NEARA have also shifted somewhat in the direction of this position. While NEARA members still occasionally express highly questionable ideas, the organization has transformed in recent years in the direction of site inventorying and preservation. NEARA's site inventories now include hundreds of "lithic" sites throughout the region. NEARA members across the region are more likely to maintain local contacts who can provide them with valuable information about site distributions. Many NEARA members have skills in specialties which most archaeologists lack, including in the hard sciences. For example, Tim Fohl, a physicist and a contributor to this volume, also has had experience working on a farm in Vermont moving rocks to create field clearance piles, and he claims to be able to clearly differentiate these from piles constructed for other purposes (Fohl 2003). He is able to communicate this knowledge to others so that they, too, can learn to recognize the differences.

The result of all of these conflicting ideas about sacred sites is a heady, and sometimes acrimonious de-

bate, involving professional and amateur archaeologists, state and local government agencies, Native Tribal Historic Preservation Offices, environmental activists, and developers. As reported in the most recent issue of our *MAS Newsletter* (Fohl 2010:4), the National Park Service has recently weighed in on this issue in favor of Native claims concerning a proposed airport expansion in the town of Turner's Falls, MA (for complete text of this decision see National Park Service et al. 2008). And some members of the professional community are now beginning to look at these sites with new eyes (Leveillee and Lance 2008). Out of all this is emerging a kind of synthesis in which parties can work together productively and find viable common ground. At last, after 375 years of neglect and abuse, Native beliefs about sacred sites are being taken more seriously, and this is beginning to have an impact upon public perception and, ultimately, public policy. Moreover, as the articles in this issue demonstrate, there is good science to be done here – quantifiable data which can generate testable hypotheses and the potential for repeatable experiments. It is the hope of the Editor of this *Bulletin* that the articles presented here will contribute substantially to this debate, and that it will assist in these developments which are, his opinion, salutary for all of the interested parties.

Curtiss Hoffman

Appendix

UNITED SOUTH AND EASTERN TRIBES, INC.
USET Resolution No. 2007:037

SACRED CEREMONIAL STONE LANDSCAPES FOUND IN THE ANCESTRAL TERRITORIES OF UNITED SOUTH AND EASTERN TRIBES, INC. MEMBER TRIBES

WHEREAS, United South and Eastern Tribes, Incorporated (USET) is an intertribal organization comprised of twenty-four (24) federally recognized Tribes; and

WHEREAS, the actions taken by the USET Board of Directors officially represent the intentions of each member Tribe, as the Board of Directors comprises delegates from the member Tribes' leadership; and

WHEREAS, within the ancestral territories of the USET Tribes there exist sacred Ceremonial stone landscapes and their stone structures which are of particular cultural value to certain USET member Tribes; and

WHEREAS, for thousands of years before the immigration of Europeans, the medicine people of the USET Tribal ancestors used these sacred landscapes to sustain the people's reliance on Mother Earth and the spirit energies of balance and harmony; and

WHEREAS, during and following the Colonial oppression of Southern and Eastern Tribes, many cultural and ceremonial practices, including ceremonial use of stones and stone landscapes, were suppressed; and

WHEREAS, the properties which comprise these sacred landscapes are threatened by the encroachments of imminent development; and

WHEREAS, whether these stone structures are massive or small structures, stacked, stone rows or effigies, these prayers in stone are often mistaken by archaeologists and State Historic Preservation Offices (SHPOs) as the efforts of farmers clearing stones for agricultural or wall building purposes; and

WHEREAS, archaeologists and SHPOs, categorically thereafter, dismiss these structures as non-Indian and insignificant, permitting them to be the subjects of the sacrilege of archaeological dissection and later

destruction during development projects; and

WHEREAS, Federal laws exist, including, but not limited to, Section 106 of the National Historic Preservation Act (NHPA) as amended with 36 CFR Part 800, the American Indian Religious Freedom Act, Executive Order 13007, and all other related laws, rules, regulations and executive orders that support the rights of Tribal Nations, but have yet to proactively influence protection of sacred ceremonial stone landscape sites; and

WHEREAS, many sacred ceremonial stone landscapes are on lands controlled by or are within projects which are advised, funded or permitted by government departments and agencies such as the Department of the Interior, Department of the Army, Department of Agriculture, National Park Service, U.S. Forest Service, U.S. Fish & Wildlife Service, Army Corps of Engineers, Federal Aviation Administration, Federal Communications Commission, National Oceanic & Atmospheric Administration, the Advisory Council on Historic Preservation, and the National Register of Historic Places; and

WHEREAS, claiming them as products of farm clearing, professional archaeologists and the SHPOs annually pass judgment on the significance and potential protection of these sacred ceremonial stone landscapes and their structures within USET ancestral territories; therefore, be it

RESOLVED the USET Board of Directors requests that all relevant government departments and agencies actively and formally facilitate consultation with the federally recognized Indian Tribes of the region regarding the sacred ceremonial stone landscapes; and, be it further

RESOLVED the USET Board of Directors recommends that the Federal departments and agencies facilitate regional workshops between Tribes, State Historic Preservation Offices, archaeologists and Federal Departments and Agencies to facilitate a better comprehension of these concerns and a correction in these dismissive and destructive local policies; and, be it further

RESOLVED the USET Board of Directors requests a draft Federal Government enforcement policy for the protection of the National Historic Preservation Act under Executive Order 13007; and. be it further

RESOLVED the Federal Government will provide the member Tribes of United South and Eastern Tribes, Inc. with assistance, when requested, for the protection of historical sites and sacred landscapes within their ancestral territories.

CERTIFICATION
This resolution was duly passed at the USET Impact Week Meeting, at which a quorum was present, in Arlington, VA, on Thursday, February 15, 2007.

Brian Patterson. President
United South and Eastern Tribes, Inc.

Cheryl Downing, Secretary
United South and Eastern Tribes, Inc.

References Cited

Binford, Lewis
1965 Archaeological Systematics and the Study of Culture Process. *American Antiquity* 31(2):203-210.

Blancke, Shirley and Arthur Spiess
2006 The Flagg Swamp Rockshelter, Marlborough, MA: A Summary. *Bulletin of the Massachusetts Archaeological Society* 67(1):2-24.

Carlson, Suzanne
2004 FAQ: Forty Years and Still Asking Questions. *New England Antiquities Research Journal* 38(1):20-28.

Carmichael, David L., Jane Hubert, Brian Reeves, and Audhild Schanche, eds.
1994 *Sacred Sites, Sacred Places.* Routledge and Kegan Paul, London and New York.

Clark, Grahame
1977 *World Prehistory*. Cambridge University Press, Cambridge, England.

Clottes, Jean-Claude, and David Lewis-Williams
1996 *The Shamans of Prehistory: Trance and Magic in the Painted Caves.* Harry N. Abrams Publishing, New York.

Cole, John, R.
1982 Western Massachusetts "Monks Caves". *Man In The Northeast* 24:37-70.

Cook, Warren, ed.
1978 *Ancient Vermont: Proceedings of the Casteleton Conference*. Academy Books, Rutland VT.

Cyr, Donald L.
1998 Ancient Chinese Maps of the World. In D. Gilmore and L. McElroy, eds., *Across Before Columbus? Evidence for Transoceanic Contact with the Americas prior to 1492*. New England Antiquities Research Association, Edgecomb ME. pp. 279-282.

Dincauze, Dena F.
1982 Monk's Caves and Short Memories. *Quarterly Review of Archaeology* 3(4):1,10-11.

Feder, Kenneth
1999 *Frauds, Myths, and Mysteries: Science and Pseudoscience in Archaeology.* Mayfield Publishing Co., Mountain View CA.

Fell, H. Barraclough
1976 *America B.C.* Quadrangle Books, New York.

Fohl, Timothy
2003 Confessions of a Former Professional Rock Popper. *New England Antiquities Research Association Journal* 37(2):15.

2010 A Note from the Newsletter Editor. *Newsletter of the Massachusetts Archaeological Society* 36(2):1-4.

Goodwin, William
1946 *The Ruins of Great Ireland in America*. Meader Press, Boston MA.

Gordon, Cyrus H.
1971 *Before Columbus: Links between the Old World and Ancient America*. Crown Publishers, New York.

Hall, Robert L.
1997 *An Archaeology of the Soul*. University of Illinois Press, Champagne-Urbana IL.

Harris, Doug
2004 Personal communication about the motivations for Native people to preserve sacred sites.

Hoffman, Curtiss
2009 Editor's Note. *Bulletin of the Massachusetts Archaeological Society* 70(1):1.

Huntington, Frederick W.
1982 Preliminary Report on the Excavation of the Flagg Swamp Rockshelter. Institute For Conservation Archaeology, Harvard University, Cambridge MA.

Leveillee, Alan
1997 When Worlds Collide: Archaeology in the New Age – The Conant Parcel Stone Piles. *Bulletin of the Massachusetts Archaeological Society* 58(1):24-30.

Leveillee, Alan, and Mark Lance
2008 On the Archaeology of Stone Piles and a Late Archaic Date from Site SK 155, RI. *Bulletin of the Massachusetts Archaeological Society* 69(2):58-63.

Mavor, James W., Jr., and Byron Dix
1989 *Manitou: The Sacred Landscape of New England's Native Civilization.* Inner Traditions International, Rochester VT.

McNiven, Ian J., and Lynette Russell
2005 *Appropriated Pasts: Indigenous Peoples and the Colonial Culture of Archaeology.* Altamira Press, Lanham MD.

National Park Service and National Historical Landmarks Program
2008 Determination of Eligibility, Turner's Falls Sacred Ceremonial Hill Site, Franklin County, MA, Town of Montague.

Neudorfer, Giovanna.
1978 A Preliminary Analysis of Vermont's Stone Chambers. In W. Cook, ed., *Ancient Vermont.* Academy Books, Rutland VT. pp. 9-13.

Pearson, James L.
2002 *Shamanism and the Ancient Mind: A Cognitive Approach to Archaeology.* Altamira Press, Walnut Creek CA.

Price, Niel, ed.
2001 *The Archaeology of Shamanism*. Routledge and Kegan Paul, London.

Seketau, Ella, Medicine Woman, Narragansett Indian Tribe
2003 Personal Communication.

Totten, Norman
1998 King Juba Remembered: A Working Hypothesis. In D. Gilmore and L. McElroy, eds., *Across Before Columbus? Evidence for Transoceanic Contact with the Americas prior to 1492.* New England Antiquities Research Association, Edgecomb ME. pp. 23-34.

United South and East Tribes
2003 Resolution 2003:022. USET Annual Board Meeting and EXPO, Uncasville CT.

Volmar, Michael A.
1996 Maugua the Bear in New England Indian Mythology and Archaeology. *Bulletin of the Massachusetts Archaeological Society* 57(2):37-45.

Whittall, James
1989 Radiocarbon Dates Associated with Stonework in New England. Work Report, Early Sites Research Society, Rowley MA.

Willey, Gordon R., and Jeremy A. Sabloff
1974 *A History of American Archaeology.* W. H. Freeman Co., San Francisco CA.

A Case for the Use of Above-Surface Stone Constructions in a Native American Ceremonial Landscape in the Northeast

Edwin C. Ballard and James W. Mavor, Jr.

Introduction

For the past 25 years, the authors have documented and recorded the presence and status of various stone constructions on the landscape in the Northeast. We have hypothesized that many of these constructions, whose locations imply an earth-sky connection (Mavor and Dix, 1989; Ballard, 1999; Martin and Martin 2006), were used as a component of Native American ritual activities.

The purpose of this article is to make the case for preservation of places and artifacts in New England, which are deemed by the authors, and others, to be important to Native American ceremonial life and that are increasingly threatened by housing development. In addition, we present the case for the use of above-ground stonework in Pre-Contact sacred practice in New England. We will document our observations at a site in Sharon, Massachusetts in the following ways:

- An analysis of the patterns of modifications to remnant glacial boulders.
- The placement of a type of "U" shaped stone construct on the landscape.
- Clear evidence of a Native American presence at the site.
- A connection to Pre-Contact Period mythology.

The King Philip's Rocks site borders an area of upland swamps which is a source of headwater streams for the Taunton and Neponset rivers, two of the largest river systems in southeastern Massachusetts. The

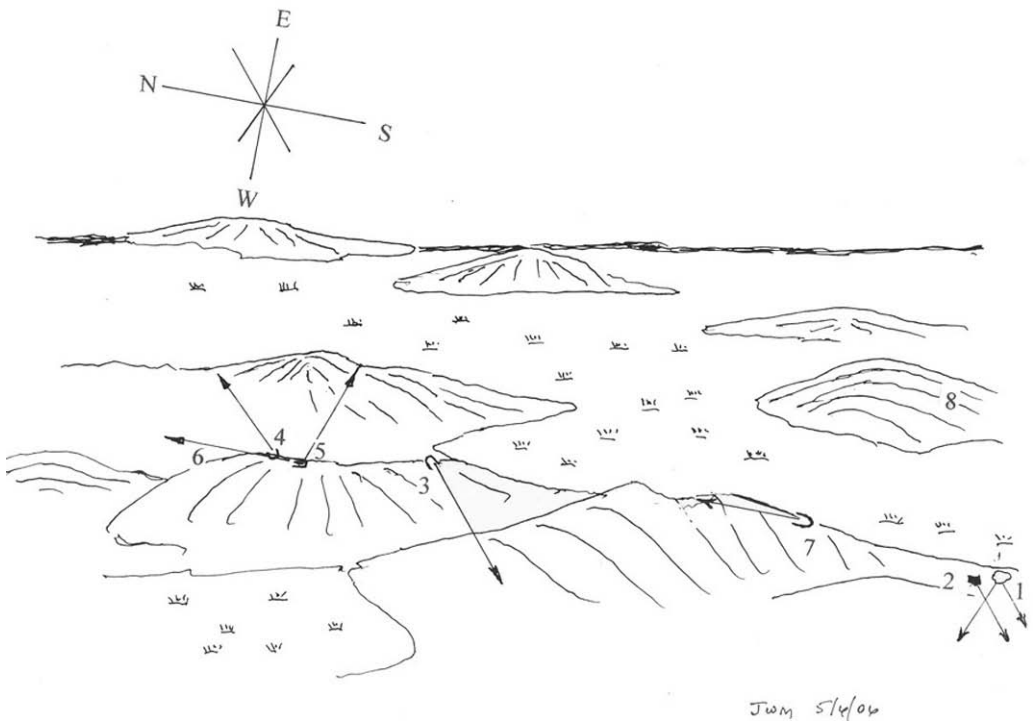


Figure 1: Skywatch Stations and Azimuths, King Philip's Rocks Site. Drawing by James M. Mavor.

irregular topography was formed from the remains of glaciers. It is comprised of a cluster of small oval hills called drumlins that surround two dumps of very large boulders (locations 1 and 8 on Figure 1, an enhanced topographic segment of the site), and a wetland area. The site had little or no agricultural or other economic value, except wood-cutting, until the housing boom of the last 15 years. Figure 1 also identifies the locations of the stone features we will be discussing and the azimuths (sight lines to the horizon) from each. We will show that these orientations suggest a ritual use function for these features.

Documentation of this site has been a subject of our individual and collective efforts since 1980. The final data for this phase of investigation were recorded in the Spring and early Summer of 2006. We propose that the recent documentation of the finding of Native American lithic artifacts on the site (Finneran 2002, Towner 2004) provides a link to our hypothesis of Pre-Contact origin for the use of these above-ground stone constructions. We will discuss the connection of features similar to the one in Figure 2 (loc. 3, Figure 1), horizon-oriented "U" shaped constructions, and the modifications made to the glacial boulder complexes shown in Figures 3 and 4 (locations 1 and 2, Figure 1) to historic Native American ritual practice and Pre-Contact traditions.

These elements and modifications are oriented to face specific sky events including solstitial sunrise and sunset and the horizon intercepts of northern constellations. We suggest that these constructions and their selected locations on the landscape are evidence of use in the past for observation of celestial bodies in a ritual context, by Native Americans. Data from the site in Sharon, MA supporting the hypothesis follows.

Figure 2: Location 3, King Philip's Rocks Site. Photos by E. C. Ballard.

Figure 3: Location 1, King Philip's Rocks Site. Photo by E. C. Ballard.

Figure 4: Location 2, King Philip's Rocks Site. Photo by E. C. Ballard.

Modified Glacial Erratic Boulders

Figure 3 shows a clump of glacial erratic boulders 7 meters high and 60 meters in circumference. The boulder clump lies at location 1 on Figure 1. Figure 5 shows a plan view of an irregular internal cavity under the boulders, about 1.5 to 2 meters high, with a floor area of about 2.5 sq. meters. As shown in the Figure 5 drawing by Fred Martin (Martin and Martin, 2006), the cavity has two openings. One, on the west-northwest side, provides an opening 1 meter wide x 2.5 meters high x 6 meters long which can be used to enter the cavity. A slab (Figure 6) bisects the entrance to the cavity. A geologist (Thompson 2000) and an archaeologist (Leveillee 2001) indicated that the tip of the slab appeared to have been worked. Another archaeologist (Stewart-Smith 2003 a, b) agreed and noted the presence of a significant amount of chippage under the organic debris at the base of the slab. When viewed from inside the cavity, the worked tip of the slab and the upper sides of the entrance passageway form a small triangular opening above the entrance. Figure 7 shows a photo, taken by Elizabeth Martin from inside of the cavity looking out, of the setting Summer Solstice Sun. Just prior to sunset at 7:37 PM on June 23, the setting sun is framed by the narrow triangular opening above the worked slab tip. At the same moment a Sun Dagger, the appearance of a controlled pattern of sunlight on a rock surface (Krupp 1983; Rudolph 1998), is formed on the back wall of the cavity. The other opening, on the southwest side of the boulder clump, has about the same internal size as the entrance aisle but its use as a possible entrance has been blocked by several stones creating an elevated window that controls the view to the west-southwest. Martin and Martin (2006) reported on a Winter Solstice sunset event at 3:51 PM, December 27, 1980 that relates to this window. Figure 8 is a photograph of the setting Sun that Elizabeth Martin took from inside the cavity through the window. The sun sets on the artificial horizon created by the boulders and is framed by the side wall of the cavity. The stones appear to be positioned for viewing this specific event. A geologist (Schoch 2001) agreed that the stones which create the narrowed aperture and control the observed sunlight event appear to be purposely placed. They assist in capturing the setting sun at its southeasternmost limit of travel at

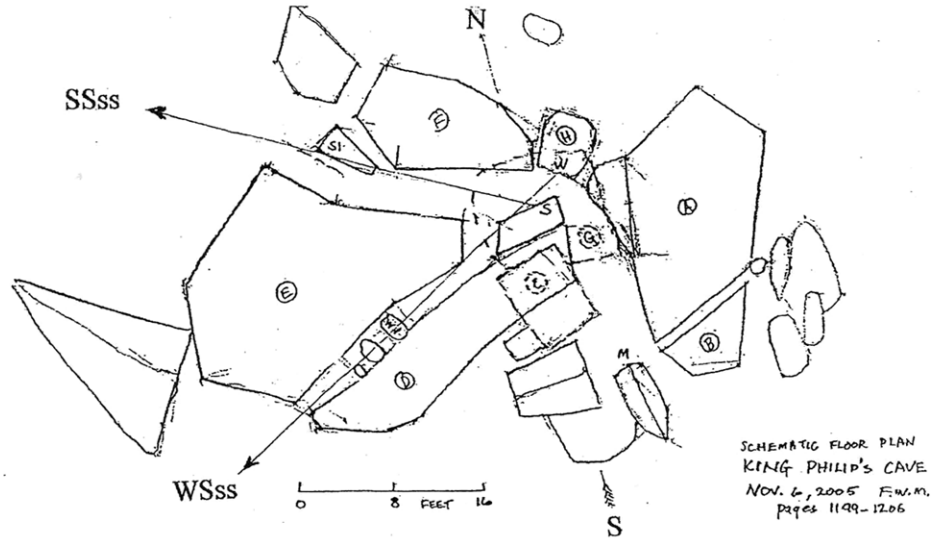


Figure 5: Schematic Floor Plan, King Philip's Cave, Indicating Primarily the Outline of Boulders at Floor Level. A,E,F,D = large boulders. These boulders frame an interior cave roofed by the sloping slab G and further loaded by boulder C. The surface of F matches E, and the surface of D matches E. Stone S1 and the surface of E make a small triangular opening and form a sunbeam which projects 6 m down the passageway between E and F onto a slumped rectangular stone at S. Stones at W1 limit the bottom edge and the surfaces of E and D limit the two upper edges of a triangular sunbeam which project 6 m down the passageway between E and D onto the vertical surface of stone H. M marks the entrance to a southern passageway. Sketch by Fred W. Martin.

sunset on the solstice, one of the most significant ceremonial days of the year for Contact Period local Native Americans (Williams 1643; Pritchard 2002:313-318). For many prehistoric societies, this event, the observation that the sun had turned, provided assurance that winter would end and that the Earth would be bountiful again. Both of the above-noted modifications appear to be designed to insure that these observations occur only during the several days of the solstice period, thus providing a means to verify that the solstice had occurred.

Figure 6: Slab Bisecting the Entrance to the Cavity. Photo by E. C. Ballard.

Figure 7: View, from inside the Cavity Looking out, of the Setting Summer Solstice Sun. Photo by Elizabeth Martin.

Figure 8: View of the Setting Sun from inside the Cavity. Photo by Elizabeth Martin.

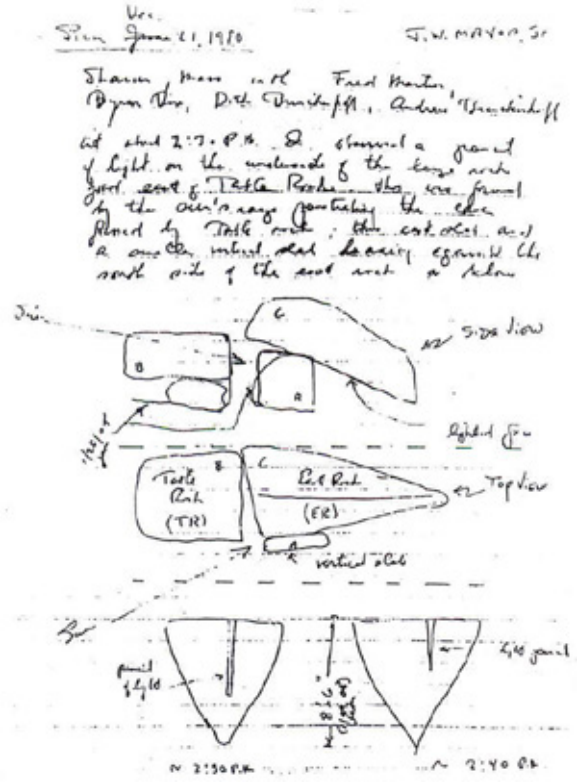


Figure 9: Copy of Jim Mavor's Field Notes at the Apparently Modified Boulder in Figure 4.

Figure 9 is a copy of field notes recorded by Jim Mavor at the other apparently modified boulder set shown in Figure 4. These boulders are at location 2 on Figure 1. It is northwest of the boulders discussed above that are shown in Figure 3. On December 21, 1980 during a Winter Solstice sunset, Jim observed the formation of a Sun Dagger prior to sunset. Figure 10 is a photograph of the near final position of the dagger on the underside of boulder C, taken from inside the small shelter under its overhang. As the solstice period sun approached sunset, the dagger contracted towards its top and disappeared. Several days later, on December 26th and 30th, during the period from noon to sunset, Jim noted that the vertical slab A appears to have been placed such that its west edge controls the light pattern generated by the southeast vertical edge of the rock table B (Mavor 2002). Figure 11 is a photograph of the near final position of the dagger taken, from inside of the complex cavity, by Fred Martin at 3:34 PM on December 22, 2005, about 30 minutes prior to true horizon sunset.

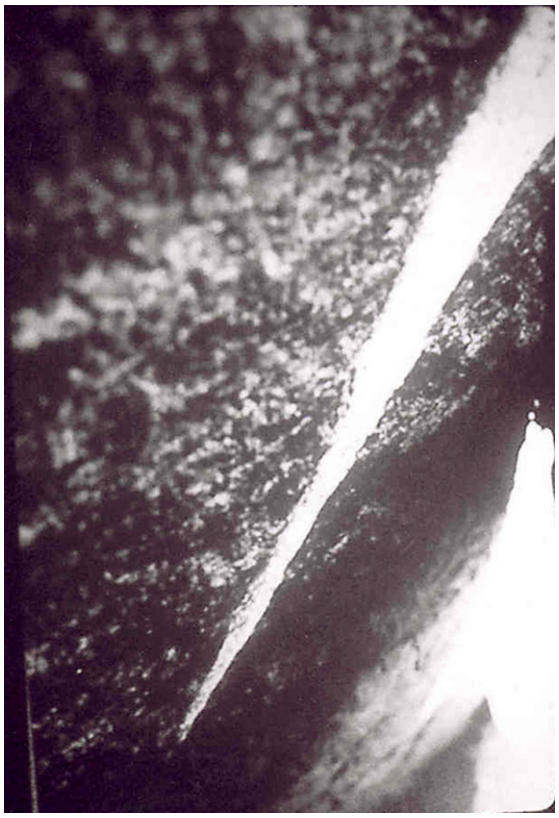


Figure 10: Near-Final Position of the Dagger on the Underside of Boulder C. Photo by James M. Mavor.

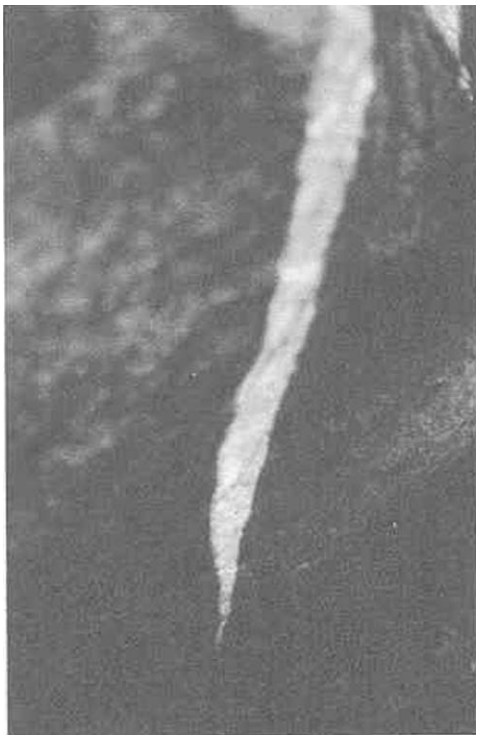


Figure 11: Near-Final Position of the Dagger, Taken from Outside of the Complex. Photo by Fred W. Martin.

Figure 12: View Illustrating That the Edges of Boulders A and B May Have Been Worked. Photo by Fred W. Martin.

The beginning of this sequence starts in late Fall when a vertical sunlight stripe, formed by the Sun shining through the space between the east edge of rock table B and the west edge of slab A, appears on the underside of boulder C in late afternoon. As the sun approaches sunset, the sunlight stripe rises and moves toward the south as the sun moves north. As shown in Figure 12, the edges of A and B may have been worked. Long-time exposure to the elements does not fully account for the condition of the surfaces of the edge of table B. Its surface is different than the matching edge of its parent boulder C. A piece of the upper corner appears to have been removed (permission to excavate is needed to verify the presence of chippage under the vegetative debris at the base). As the days progress toward the solstice, the setting sun is blocked from setting on the horizon by the large boulder set HB/HD (Figure 13). In early December, as the date of the solstice nears, the Sun sets progressively lower against the boulder face, and the Sun Dagger appears at a progressively higher position on the underside of C, as noted in the photograph, Figure 11. As shown in Figure 13, at Winter Solstice the sun sets on the far horizon just free of interference of the foresight boulder set HD/HB. During the setting sequence on Solstice about 30 minutes prior to sunset, the lower portion of the dagger disappears. The top triangular shape, governed by an area of apparently removed material on the upper edge of table rock B, remains visible on the underside of boulder C for a short period, reaching its highest point of the year before it, too, disappears.

Discussion

The precision of the sequence of events displayed provides an opportunity for this complex to have been used as a simple counting device for determining the correct day for the celebration of Winter Solstice, an event noted as a major Contact Period day of Indian celebration (Williams 1643). Similar day counting practices are rooted in prehistory by many sky-viewing cultures. Examples include:

- The Zuni day count period Shalako, prior to Winter Solstice, which is used to determine the actual date of the event (Stevenson 1901).
- The Christian Advent period before and the 12 days of Christmas after the Winter Solstice.

Jim Mavor, using his and Fred Martin's early field notes and additional data collected in the December 2005 solstice period, constructed a working model of the Figure 4 boulder set that aided us in deciphering the event sequence. The model can be adjusted to display the daily movement of the sunlight stripe, showing the progress of the image over time towards the day of the Winter Solstice.

There are published references to a similar control of sunlight at other prehistoric sites. Krupp (1983:129, 152-156) discusses three reported instances of Native American use of Sun Daggers in association with solstice events, one at Fajada Butte in Chaco Canyon, New Mexico, another at Hovenweep in the Four Corners area, and one at Burro Flats in the Simi Hills north of Los Angeles. Rudolph (1998) details a Solstice sunrise dagger event at the Willow Creek site in northern California, prior to Winter Solstice. Evidence of this type has been considered irrelevant by many professional archaeologists in the Northeast, who are usually not familiar with the universality of Pre-Contact ritual practices and the connections to the cyclic movements of the sun, moon, and stars. The subject has therefore been summarily dismissed as not worthy of in-depth investigation, or (as in MHC 2003b), has been subjectively associated with non-related post-Contact Period constructions (e.g. Neudorfer 1979, Cole 1982) or mistakenly associated with speculative archaeological fantasies (Williams 1991).

The result is that, to the detriment of the prehistoric record, there is little written on the methodology of Native American ritual activity in the Northeast other than that related to the analysis of grave goods. There are, however, several local area references to the use of structures, hilltops and solstice by Native Americans in a ritual context:

- *A Key into the Language of America* by Roger Williams (1643), in which he refers to the ritual use by local Native Americans of:
  - Hilltops for appeal to the Gods,

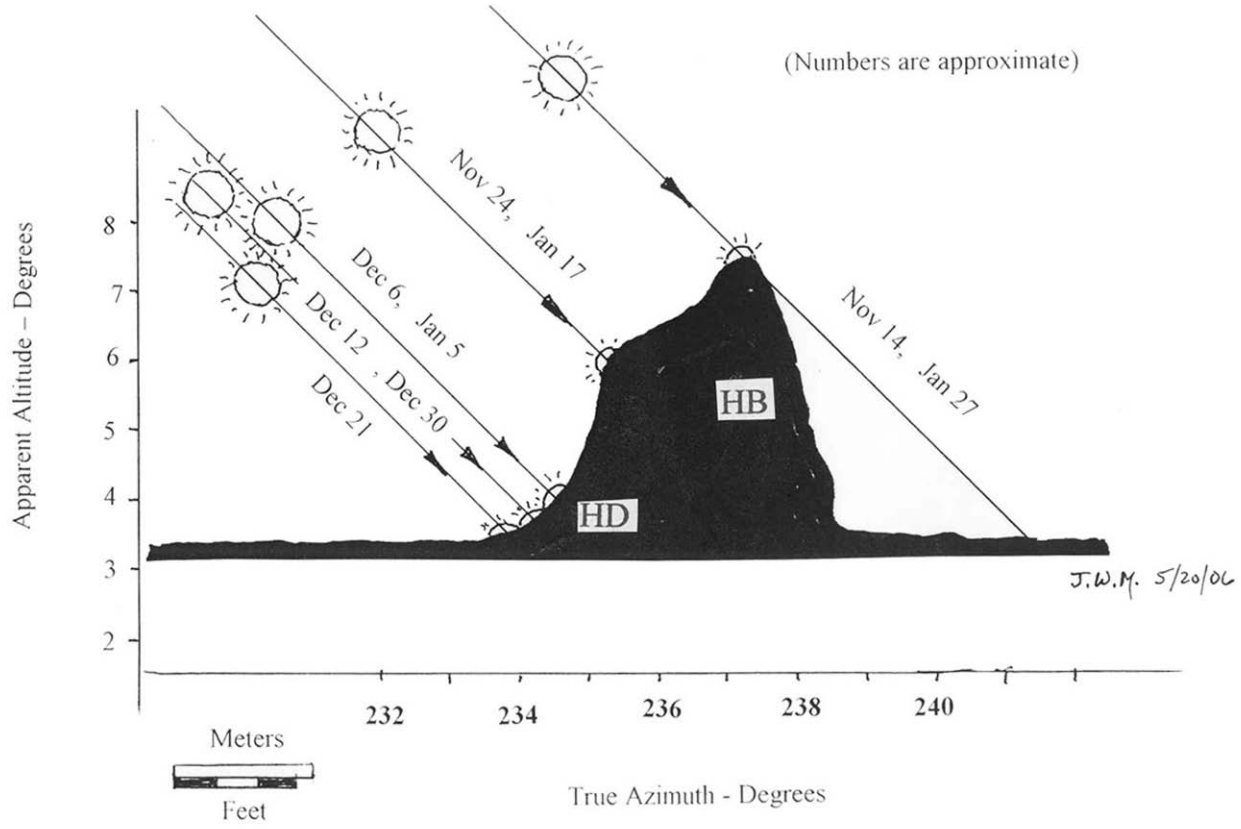


Figure 13: Sun's Path and Horizon as Seen from Sun Dagger. Diagram by James Mavor.

  - The Sun at Winter Solstice (a celebration of "their kind of Christmas"),
  - The knowledgeable use of stars and the Big Dipper.
- *The Beechwood Confederacy 1709 – 1809*, by Leonard (2003), who notes that just prior to King Philip's War, in 1673, Tispaquin, a Sachem in the region of Lakeville, Massachusetts, took the precaution of having a significantly located viewing hill in the Betty's Neck area entered into the deed records at Plymouth to document ownership by his kin. This was a good move, since he was beheaded in 1676 at the end of King Philip's War. The deed was subsequently upheld, thus preserving the record of its significance. Four acres of the hilltop was taken by order of the Selectmen of Middleboro in 1690, and then leveled, to prevent its use by local Indians. A "U"-shaped construct sky-viewing site is on a Summer Solstice sunrise line from the top of this hill (Ballard, 1999).
- "Anthromorphic Fertility Earthworks of Southeastern New England", in which the late Wampanoag Tribal Historian, Great Moose (Gardiner 1998) discussed the Pre-Contact ritual use of three hilltops (Dancing Hills) and hilltop effigies in Southeastern Massachusetts.
- *The Voice of the Dawn*, in which Wiseman (2001) touches upon the use of above-ground elements in a Native American sky use context in northern New England.
- *The Native New Yorkers*, where Pritchard (2003) discusses the prehistoric location of Native American burial sites along solstice lines emanating from a hilltop near Montauk on eastern Long Island, NY. A former sky-viewing site in Rehoboth MA, with horizon-focused "U"-shaped laid-up stone constructs, appears to have been used similarly. Two of the "U"s, one facing Equinox sunset and the other Summer Solstice sunset, used the south and north shoulders of a glacial esker as foresights. The esker was removed in gravel operations in the early 1950's. During excavation, several Native American

burials were destroyed (Ballard 1999:Fig. 5, constructs 11 and 13).

"U"-Shaped Constructions

The second type of construction found on the Sharon site is illustrated in Figure 2. The back of the structure is a large natural boulder. The front of the structure is built of laid up stone with 2 arms extending outward completing the "U"-shaped opening. There are four additional similar "U" constructions on this site. Constructions of this type are usually one to two meters in diameter, assembled from local stone. About 100 have been reported at over a dozen other locations in eastern and central New England, including three other locations in Sharon (Ballard 1999). One site is in a State Park 2 kilometers to the southeast of the King Philip's Rocks site; another is 4.5 kilometers to the northeast. A third site, with horizon-oriented "U" constructions which were placed on the upper surface of low rectangular platforms of laid-up stone, is located on a ledge shelf at the edge of a 30 meter drop-off near the Sharon/Foxboro town line about 1.5 kilometers to the west of the King Philip's Rocks site. There are several medium-sized stone piles at this location, clearly not related to agricultural activities.

All of these "U" type constructions are in remote areas on high ground. Their locations are all chosen so that the opening faces a natural or man-made horizon marker to assist in viewing a sky event, like a solstice sunrise or the position of a northern constellation. Many of these sites were found over the years by the authors, using surface walkovers and mapping strategies in suspect areas (Mavor and Dix 1989; Ballard 1999). Others were found by following up local references.

Chartkoff (1983) discusses the ritual use of similar structures, which he refers to as "prayer seats", by high-ranked Yurok in northern California. Those structures were situated on peaks or high rocky outcrops with little vegetation to restrict the view. The Yurok speak an Algonkian-related language. Reeves (1994) describes the high ground location and ritual use of similar "U"-shaped constructions, which he refers to as "vision quest" structures, in northern Montana and southern Alberta, Canada. They are used by the Algonkian-related language speaking Blackfeet. These "U" structures are found on and around Chief Mountain, Ninaistakis, the sacred mountain in the ritual landscape of the Blackfoot tribe. Some of those "U"s point toward the mountain from locations as far away as 40 to 70 kilometers.

The "U"-shaped sky-viewing constructions discussed here are located in positions 3, 4, 5, 6, and 7 on two separate drumlins as shown in Figure 1. They are north of the two previously discussed rock clumps, which are located at positions 1 and 2. The "U" structure shown in Figure 2 is at position 3 in Figure 1, and faces southwest towards a point on the north slope of a nearby drumlin which could have been used as a natural horizon. An observer will see the sun set on Winter Solstice on this line. The construction of this particular "U" differs from that of the four others on this site. In addition to the common "U" configuration, this construct has a mantel of stones across the face of the supporting boulder, connecting the arms. It is similar to several "U" constructions which were observed at a former site in Groton, Massachusetts, 70 km to the northwest (Ballard 1999). This suggests a shared ritual connection across tribal boundaries. When approached from a distance, the mantel gives this "U" structure the appearance of being a cave-like opening into the Earth; i.e., an emergence structure similar to the Kivas of the southwestern United States (Krupp 1983: 231-233). Here we suggest that each of the "U"s are places to connect the supplicant on earth with the sky and the gods above. They became symbolic world entrances used as a component of Native American ritual in New England, as noted by Bragdon (1996), and by Hall (1997:129) for Hopewellian earthen "U" constructions in Ohio.

There are three other "U"s nearby on this drumlin at location 4, 5, and 6 on Figure 1. Their constructions differ from that of the "U" shown in Figure 2 and from each other. This suggests they were built at different times or by different users. Two are on the drumlin's upper surface about 60 meters north of the "U" shown in Figure 2. The "U" at position 4 is on the east side near the northern peak and faces east-northeast toward Summer Solstice sunrise. The "U" at position 5 is located slightly downhill to the southeast. The azimuth from this structure points to the top of another drumlin about 250

meters away. Its function has not been identified. This azimuth is also present at several other sites. We strongly suggest that the solstice-oriented constructions discussed above are markers indicating Native American ritual use, as noted by Williams (1643).

The Big Dipper and the Hole in the Sky

At the local latitude, which is about 42 degrees North, the Big Dipper, called by northeastern Native Americans The Bear (Williams 1643), is always above the horizon during its cycle around the North Pole. At present, the lowest star in the tail of the Dipper is 1.4 degrees above the horizon when it crosses the meridian at its lowest point in the early evening in mid-January. As observed at King Philip's Rocks, and at several other sites, the selected location for "U"-shaped constructions that face true north is always below the top of the hilltops chosen as horizons. They therefore provide an observer at the construct with a horizon (as shown in Figure 16), so that the Dipper's tail star, when viewed in winter in the early evening, appears to brush the Earth, symbolically connecting the Earth to the Sky.

Figure 14: U-Shaped Construction, Position 7. Photo by E. C. Ballard.

Figure 15: U-Shaped Construction, Position 6. Photo by E. C. Ballard.

In studying the structures at positions 6 and 7 we observed several differences. Their directional azimuths are the same, true North. They use a high point on their hill as a natural horizon and they are located below the high point facing uphill. However, their constructions, and positions on their respective drumlins, are significantly different. As shown in Figure 14, the "U" at position 6 (Figure 16) has a vertical slab as its backrest and has short laid-up stone arms extending outward. It is located slightly above the low point of a shallow saddle 34 meters downslope from the drumlin top and 1.8 meters (3 degrees) lower than the horizon. The "U" at position 7 (Figure 15) is really a D-shaped solid pile of stones with arms extended outward from the arc of the D. It is 190 meters down-slope and 15.8 meters (4.8 degrees) below its facing hilltop. This strongly suggests that these structures were used at different times for viewing the northern sky, by different observers. The differences in location for these two North facing structures lead us to an interesting set of possibilities. For the local latitude, a review of astronomical tables shows that 1000 years ago the Dipper's tail was about 5 degrees higher in the sky at its lowest point. Due to precession, a slow drifting of position in the sky caused by the wobble of the Earth on its axis, it has dropped to its present location at a rate of about ½ degree per 100 years. This suggests that for an observer lying down in a "U" and facing the North, the azimuth of the "U" at location 7 is pointed about 1.8 degrees higher in the sky than the "U" at location 6. The 1.8 degree viewing angle difference for these north-facing constructions suggests a 350 to 400 year separation in time for the use of these "U" constructions as sky object viewing. Observation from a seated position is suggested by the use of the term "Prayer Seats".

We calculate that in that case the use-time difference would increase to about 550 years.

The literature indicates that for the Native Americans in the Northeast the Bear and "The Hole in the Sky" (the area within the orbit of the North Star Polaris) were significant sky objects:

- From the story about creation from the Iroquoian speaking Huron about the pregnant Woman from Above the Stars who, with her dog, fell through the Hole in the Sky while chasing a bear. She landed on the back of Turtle. Her daughter subsequently gave birth to the twin creator/transformer gods (de Brebeuf 1636). In a fight with his brother one of the twins is wounded in the side by a blow from the horns of a stag used by his brother as a weapon. The blood falls to the ground and becomes flint.
- The Woman who Fell from the Sky is also a key element in southern Algonkian creation mythology (Gunn-Allen 2002).
- Turtle is the bearer of the Earth that floats on the primal sea in the Earth Diver myth present in both northeast Asia and North America (Campbell 1959: 274-275; Hall 1997:19).
- For the Mohawk, the dog became the North Star (Rustig 1988). The Bear becomes the Dipper Bowl (Volmar 1996). The Bear (Dipper) connects the Earth to the sky (Speck and Moses 1945).
- The Munsee/Mahigan (Algonkian) Big House midwinter renewal ceremony highlights the Bear cycle. (Speck and Moses 1945, Pritchard 2002: 282-285 re: New York State; Schlesier 1987: 175-176 re: Oklahoma). The Bear (Dipper bowl) leaves his den (Corona Borealis) in the spring. The Bear is followed by seven hunters (the three stars in the Dipper's tail plus four stars from the constellation Bootes, includ-

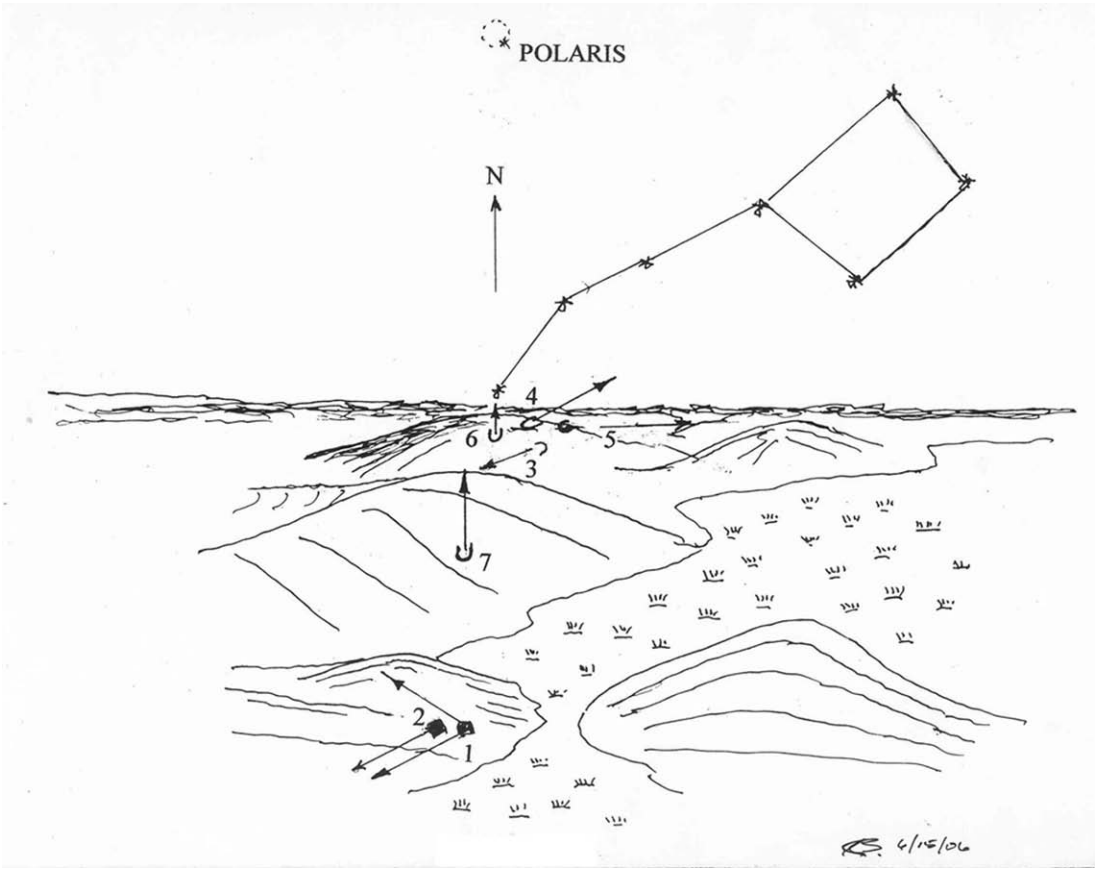


Figure 16: Relationship of U-Shaped Constructions to Northern Constellations. Drawing by E. C. Ballard.

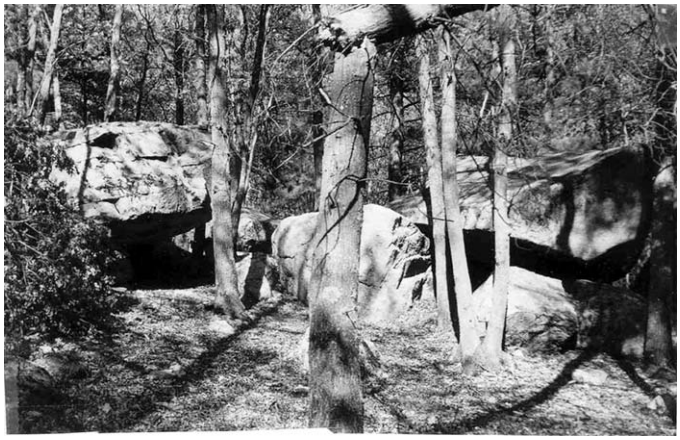


Figure 17: King Philip's Rocks Shelter. Photo by E. C. Ballard.

ing the major northern star Arcturus). When the hunters slay the bear in the Fall, the bear's blood falls to Earth, turning the leaves red. The rendering of the bear's fat is signaled by the first snowfall. The ceremony was performed in mid-January and a depiction of the Bear cycle was laid out on the floor of the Big House. The tail of the Dipper crosses the meridian in early evening about January 15th (a prelude to the Bear returning to the sky?).

References for the use of structures for sky viewing include:

- Gunn-Allen (2002), in a discussion about the Southeastern Algonkian Creation ceremony, refers to above-ground "vision" structures in the northeast named for the God Hobbomock. He is equivalent to one of the paired Southeastern Transformer Gods, Oke, the one responsible for illness and the other things that make life difficult. Oke is the God to whom one appealed for assistance in overcoming these obstacles. Other regional Algonkian names for this God include Mittand, Squantum (Bragdon 1996), Moshup, Cheepi (Simmons 1986), and Glooskap (Leland 1884).
- Bragdon (1996) comments on the hierarchical structure from *pniese* to *pau waus* who were responsible for eastern Algonkian ritual conduct and the practice of prayer appeal to one of the twin transformer gods, Hobbomock.

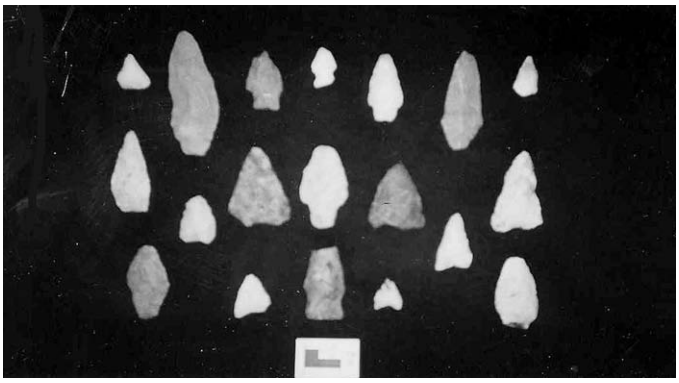


Figure 18: Artifacts from King Philip's Rocks Site.
Top Row (left to right): Beekman Triangle, Knife, Wayland Corner-Notched, Sylvan Side-Notched, Neville, Stark, Small Triangle.
Middle Row: Jack's Reef Pentagonal, Squibnocket Triangle, Atlantic (snapped base), Adena Long Stemmed or Genesee, Biface Tip, Dalton (?), Preform.
Bottom Row: Stark, Squibnocket Triangle, Orient, Squibnocket Triangle, Scraper. Photo by E. C. Ballard.

- Simmons (1986) collected and discussed oral history stories about the primary Native American transformer gods in southeastern New England, referencing Moshup and his equivalent, Hobbomock. With the advent and assimilation of the religious beliefs of the English, both were transformed into the Devil (Salisbury 1982) and, according to an Indian who overheard Reverend Bourne of Cape Cod shouting in his sleep, Bourne was wrestling with the Devil, and "the Devil came from the North . . . at night." (Simmons 1986:85)
- Day (Foster and Cowan,1998:176,183-194) notes that the Algonkian at St. Francis in Quebec referred to "Obamakuit the Wanderer". In many ancient cultures, the "wanderers of the sky", the planets, are gods, while the stars and constellations are animals (De Santillana and von Dechend 1969). A significant element of the St. Francis population were Sokokis, originally from the area of the central Connecticut river. This is the area where a sky-viewing site is located, at Acworth, NH (Ballard 1999). Day also notes that Glooskap "came from an island with his grandmother in a canoe" (stone boat?).
- Nicolar (1893) reports that Glooskap came from the North and departed to the West, leaving be-

hind the stones for making weapons. As noted above, this is a responsibility the Hurons assigned to one of their twin Gods.

These snippets from oral traditions are remnants from memory that relate to the use of elements of the sky in a ritual context, when viewed from selected locations, by pre-Contact Native Americans in the Northeast. Based on the data collected from the King Philip's Rocks site, and from similar observations from structures we have studied at other sites, we suggest that the constructions on the Sharon site were used in a ritual context related to these stories, and that their use was Pre-Contact.

Other Native American Connections to the Site

The King Philip's Rocks site complex is located about 0.6 km from a documented prehistoric site. The rockshelter shown in Figure 17 is identified on the Brockton U.S.G.S. topographic map by a name ("King Philip's Rocks") that connotes a Native American connection. Recent research on the site has identified a past Native American presence. Figure 18 is a photograph of Late to Transitional Archaic (ca 6000 to 2700 years B.P.) lithic artifacts reported to have come from the site (Finneran 2002). They were collected by a now-deceased local avocational investigator. Also, in possession of the Sharon Historical Society is a taped oral interview with a local resident (Towner 2004). (Fred Martin and Ted Ballard were present during the taping of the interview.) Mr. Towner described visits to the site with a now-deceased local antiquarian and historian, Mr. Walter Reeve. Mr. Reeve showed him three locations on the site where similar types of Native American artifacts had been recovered. Two of the locations were adjacent to the glacial deposits shown in Figure 3; a third was in a low area 20-30 m to the south of the rockshelter shown in Figure 17 (loc. 8 on Figure 1). Mr. Towner stated that he had handled a pestle and a small mortar that had come from the area of location 1. In addition, he had observed other stone artifacts that had been recovered from adjacent locations by Mr. Reeve. Near the rockshelter (Figure 17), in the presence of Mr. Towner, Mr. Reeve, who was a trained geologist, scratched the surface with a digging tool and turned up stone chippage which he stated was not native to the area. At the same time, Mr. Reeve indicated the presence of several fire pits about 15 centimeters below surface at that location. We do not necessarily suggest that the constructions discussed above are directly related to the time frame associated with the lithics shown in Figure 18. The artifacts merely confirm an early Native American presence. The finding of the mortar and pestle suggests an extensive period of usage. The use of a Native American name reference on the local topographic map, in other historical documents in Sharon (Wade 1976), and in oral traditions of 20th century use by local Native Americans (Elizabeth Andrews 2006), suggests a continuity of Native presence, both preceding and after the Contact Period.

Whence the Paradigm?

The lack of acceptance of a prehistoric context for of any above-surface stone constructions in New England has evolved from the existing paradigmatic belief that Native Americans in the Northeast did not use stone constructions prior to the Contact Period. This lack of recognition has severely affected our efforts at encouraging preservation. There are many factors which have led to this impasse. There is no reliable way to date stone constructions without excavation. (The authors agreed in 1989 not to excavate "U" constructions.) In other parts of the continent, prehistoric cultures and belief systems remained intact for an additional 250+ years after the Contact Period. This provided an opportunity for mid- and late 19th century travelers and ethnographers to observe and record then still-existing cultural practices, thereby providing a window into the past that was more closed in the Northeast by the continuing effects of intercultural conflicts of the 1600's. It remains mostly closed to this day, since as also discussed above, data from outside of New England has seldom been considered applicable to local studies (MHC 2003b). The paradigmatic disconnect has deep roots (Mavor and Dix 1989). Part of its legacy is that history is always written by the winner. From 1616 to 1675, the local Contact Pe-

riod Native social culture was decimated by the effects of disease, war and theocratic edict (Jennings 1975; Lepore 1998). What little information that remains has been garnered from isolated remnants of scattered residual oral traditions, artifacts that are impervious to rot found in the earth during excavations, and by wading through the theological bias of the historical record.

Another impediment is the bias brought from Europe by our cultural forebears, the Pilgrims/Puritans, who, on their arrival in Massachusetts 400 years ago, accidentally collided with the sky-based theology of the American Neolithic. They were encumbered by the burden of their adherence to the Judaeo-Christian belief system, a structure of tenets refined over the 2300 years that had elapsed since their doctrinal predecessor, Josiah, had killed the competing sky priests of Baal. Josiah brought his subjects off the hilltops and down to the reconstructed temple to worship (2 Kings 23:1-24). Our predecessors followed in his religious footsteps, basing early Massachusetts law on the text "discovered" by Josiah (Deuteronomy 2:31-34 and 17:2-5). Native American ritual customs were condemned as Devil-worship. Edward Winslow, the first Governor of the Plymouth Colony, recognized elements of similarity in Native American religious practice to Puritan/Pilgrim Christianity. One of their paired gods (Keitan/Michabo) was comparable to the Biblical Creator. The other god, Hobbomock, was responsible for the things that made life difficult (illness, conflict, crooked rivers, mountains etc.). Contact with him required the supplication of a *pneise* or *pau waus*. Winslow suggested a strategy of equating this god with the Christian Devil as a means of undermining the *pau waus*' authority, in order to gain control over the local Native population's socio-ritual structure and thus facilitate conversion and suppression (Salisbury 1982:136-139).

John Eliot, not recognizing the depth of Hobbomock's role in Native religion, had this strategy backfire during his first attempt at proselytizing at Dorchester Mills in September, 1646. The native Sachem, Cutshamoquin, violently resisted the comparison of Hobbomock to the Devil, and Eliot scurried back to Boston (Jennings 1975:238-242). For the Native Americans, the fallout was a Bay Colony General Court edict in November 1646 that forbade the practice of Native religion under pain of death, and that authorized the setting up of special "villages" to make it easier to establish theocratic and political control over the local Indians. Their religious activities were condemned as Devil-worship.

The influence of these edicts still persists. In addition, in the Northeast, increasing population density, the plow, and an ecological environment not friendly to preservation of non-lithic remains, combined to erase most of the contextual record of the prehistoric period. The result is that we are left trying to interpret the past working with the residual remains of a buried record and a negative mind-set about the capabilities of the prehistoric population. This mind-set has been reinforced by the narrowness of the methodology of interpretation widely employed in the academic environment. "More often than acknowledged inference to the best hypothesis is a ranking of probabilities, not certitude." (Kehoe 1998)

Some examples of inferences implying certitude regarding use of above-ground stone constructions that are cited to reinforce the paradigm and deny relevance for other constructions, follow:

- The continuing use of hearsay to attribute the construction of Queen's Fort in Exeter RI to the Post-Contact Period. This neglects the clear evidence of sky viewing use at Winter Solstice (Mavor and Dix 1989), which supports the case for a much older Pre-Contact use hypothesis.
- The conclusion of Hall and Woodman (1972) that the "Beehives" ("U" structures) at Acworth and Swansea NH were 19th century trapping structures was influenced by an apparent transposition error made when recording field notes for a reported azimuth measured at Acworth,. The error confounded their horizon observation data, caused them to miss the connections to Winter and Summer Solstice sunrise, and thus limited the scope of their analysis. Their report did not address the presence of several other "U" constructs present on the site. In addition, no explanation was offered as to why it made sense for trappers to climb a steep trail to the top of a mountain in Swansea, NH to trap foxes in enclo-

sures oriented to sun and northern constellation horizon events (Ballard 1999). Their trapping use conclusion subsequently became a tenet of the prevailing paradigm. (Snow 1980; Cole 1982).

- In the midst of an atmosphere of proposed exotic overseas contacts as sources for much of New England's relict stonework, Neudorfer (1979) identified an agricultural storage use for a class of stone chamber constructs in Vermont. With this limited study of one structure class, coupled with the above two citations and a dearth of information on pre-Contact Native cultures in New England at that time, the paradigm "Native Americans in the Northeast did not use stone constructs prior to the Contact Period" was reinforced and accepted as a tenet by much of the professional archaeological community in New England.
- Cole (1982) reported on stonework similar in context to that discussed by Neudorfer, and cited the Hall and Woodman report's conclusions when comparing structures that had little or no commonality in location or construction.
- The Massachusetts Historical Commission, citing some of the above sources as authoritative, has categorically declared of the King Philip's Rocks site (2003a) that, " . . . there is no evidence that the boulders were placed by other than natural forces, nor is there any recorded evidence of human habitation in the area. Concentrations of glacially deposited boulders are not uncommon in New England, whereas deliberately placed astronomically aligned stones of ancient origin have never been conclusively identified in this area. Stone alignments like King Philip's Rocks have without exception been found upon professional archaeological erxamination to be either natural deposits or the product of colonial period or later construction." They have provided no bibliographcial citations for the latter claim.

In documenting our hypothesis, we have used the guidelines noted by Neudorfer (1979) for minimizing the excesses inherent in relying on "repeating past anecdotal, pre-paradigmatic investigations". We have:

- Collected a body of facts based on observation and measurement.
- Used an analytic methodology.
- Made a connection to the norms of a culture.

In addition, we have followed the admonition in the last paragraph of Fitzhugh's foreword to Neudorfer (1979), "Professional scholars must also do a better job at working together with local societies and amateur groups in identifying, clarifying and preserving the remarkable traditions of our pioneers and native predecessors." We have worked with other avocationals, representatives of the Native American community, and a few professional archaeologists on this and other projects. For the most part, professional scholars have declined involvement.

In addition to our observations discussed above, there are several subsequent published reports of pre-Contact stone constructions that provide evidence of early Native American use of stone structures in New England. These strongly suggest that the paradigm needs to be revised. Some examples follow:

- Late Archaic lithics were found at the base of a drip-line stone wall at the Flagg Swamp Rockshelter in Marlboro, Massachusetts, (Huntington 1982). In addition, Blancke (2006) discusses the apparent ritual burial of a bear associated with the Archaic level at this site.
- An extensive stone prehistoric fish weir was found in Central Maine (Petersen et al. 1994).
- As reported by Mavor and Dix (1989), a 1.7 cm square potsherd of low-fired earthenware, Woodland period pottery (Vandiver 1978) was found 7 cm below ground surface under one of a group of 70 stone piles on a ridge spur at an altitude of 500 m in South Royalton, VT.
- A pair of ^{14}C dates, 790$\pm$150 B.P. (GX-9684) and 875$\pm$160 B.P. (GX-9685), were obtained from charcoal samples found during the excavation of a stone mound in Freetown, Massachusetts. The mound was located in an area of approximately 1000 stone pile constructs in a non-agricultural context. The charcoal deposits were found below surface in front of an internal stone "U" construct that framed an area that contained 120 chunks (totaling 4.5 kg) of red ochre, a white quartz effigy, an anvil, and a shaped standing slab (Mavor and Dix 1989).

- In the excavation of a 180 cm (90 cm exposed) Standing Stone, which was a component of a sky-viewing site in the Royalton, Vermont area, Mavor and Dix (1989) reported finding a greenstone chopper and a deposit of red ochre on bedrock, about 1 meter below grade, adjacent to the stones bracing the lith.
- Winter (2006) published an update of the results of the 1954 Brennan pit excavation at the Call site in Billerica, MA. He noted that the central feature of the mortuary pit was a 40 cm high triangular shaped standing stone. The stone was propped, extended upward into the loam, and had a drill deposited at its base alongside a charcoal deposit. This juxtaposition is similar to those discussed above. At a slightly higher level there was a deposit of mortuary remains packed around the vertical stone. As noted by Winter, Dincauze (1968:81; 1972:57) referred to this excavation in her studies of the 4000 year-old Atlantic phase.
- Four "U" shaped stone constructs with significant horizon azimuths, two with ^{14}C dates from charcoal, 800±150 BP (Beta-54901), 860±50 BP (Beta-62401), were excavated at a site in Barrington, RI. The constructs intruded into a Late Archaic to Middle Woodland locus adjacent to a known Native American burial site (Ballard 1999).

Concluding Remarks

Over the past quarter century, the authors have studied above-surface, horizon oriented, man-made stone constructions in the Northeast. We have observed their structure, location and interrelationships. Thomas (1978), while noting the important benefits of using statistics in evaluating archaeological data, discusses problems inherent in the use of significance tests. We recognize that for many of our observations, due to the horizon being obstructed by the growth of vegetation, we are unable to obtain precisely verifiable data. This, coupled with small sample sizes, led us to follow the suggestions of Romain (1992), for dealing with similar types of archaeoastronomical data. Based on two clear data subsets (sun cycle and northern constellations), we have relied on the use of the probability of occurrence and logic-congruency testing for evaluating the data collected at this site:

- There are multiple alignments on this site, some of which have been verified.
- There are similar patterns of alignments at other sites, some of which have been able to be verified (Ballard 1999; Mavor and Dix 1989).
- The alignments are consistent with elements of local Native American culture.

We conclude that the constructions on this site relate to use of ceremonial landscapes by pre-Contact period Native Americans. These landscapes were part of a fundamental, widespread belief system present across North America. Due to the continuing denial of relevance for above-ground stone constructions to pre-Contact culture by the professional community, a significant number of the sites we had previously identified have been lost to housing developments without an opportunity to conduct salvage operations:

- Groton, MA, mid to late 1990's.
- Rehoboth, MA, 1998/2001 (including evidence of burials on a Solstice sunset line).
- Sharon, MA, 2001/2003.

In addition, formal denial of applicability (MHC 2003a, 2003b) severely limited the options available to the town of Sharon to protect the integrity of the King Philip's Rocks site. We have also observed that "enhancements" have been made to above-ground structures in nearby State Parks.

Recognizing the need for a higher level of protection, we strongly advocate that this particular site, and others with similar elements, be recognized as probable Native American sacred sites. In addition we ask that, based on the evidence presented here, the paradigm "Native Americans in the Northeast did not use stone constructions prior to the Contact Period" be revised, and that all appropriate actions be taken to preserve, where possible, and at the least to conserve iden tified sites, and that such efforts receive the consuch efforts receive the consideration and support of the professional archaeological community.

Acknowledgements

The authors acknowledge the contributions made to this article by many others who have walked the landscape, including several members of the Native American community. We especially thank Fred and Elizabeth Martin for their stewardship of this site that resulted in its preservation.

Editor's Note: A version of this article previously appeared under the same title in the NEARA Journal v. 40(1) 33 ff. (2006). At the 2006 Town Meeting in Sharon, the citizens of Sharon voted to purchase the privately owned portions of the King Philip's Rocks site to preserve it from an imminent threat of destruction.

References Cited

Andrews, Elizabeth
2006 Personal Communication with Ted Ballard.

Ballard, Edwin C.
1999 For Want of a Nail. *Bulletin of the Massachusetts Archaeological Society* 60(2):38-54.

Blancke, Shirley and Arthur Spiess
2006 The Flagg Swamp Rockshelter, Marlborough, MA: A Summary. *Bulletin of the Massachusetts Archaeological Society* 67(1):2-24.

Bragdon, Kathleen
1996 *Native People of Southern New England 1500 - 1650*. University of Oklahoma Press, Norman OK.

Campbell, Joseph.
1959 *The Masks of God*: *Primitive Mythology*. Viking Press, New York.

Chartkoff, J.L.
1983 A Rock Feature Complex in Northwest California. *American Antiquity* 46(4): 745-760.

Cole, John, R.
1982 Western Massachusetts "Monks Caves". *Man In The Northeast* 24:37-70.

de Brébeuf, Jean.
1636 *On the Belief Manners and Customs of the Hurons. Jesuit Relations: The Hurons,* Volume X, Part II. Translated by James McFie. The Burrows Bros., Cleveland OH.

De Santillana, Giorgio, and Hertha von Dechend
1969 *Hamlet's Mill.* David R Godine, Boston MA.

Dincauze, Dena F.
1968 *Cremation Cemeteries in Eastern Massachusetts. Papers of the Peabody Museum of Archaeology and Ethnology* 59(1). Harvard University, Cambridge, MA.

1972 The Atlantic Phase: A Late Archaic Culture In Massachusetts. *Man in the Northeast* 4:41-61.

Finneran, Joseph
2002 Personal Conversation with Ted Ballard.

Foster, Michael K. and William Cowan, eds.
1998 *In Search of New England's Native Past: Selected Essays by Gordon M. Day.* University of Massachusetts Press, Amherst MA.

Gunn-Allen, Paula
2002 *Pocahantas.* Harper and Row, San Francisco CA.

Gardner, Russell H. (Great Moose)
1998 Anthromorphic Fertility Stoneworks of Southeastern New England: A Native Interpretation. *Bulletin of the Massachusetts Archaeological Society* 59(2): 57-65.

Hall, Jonathon and Eric.Woodman
1972 Beehive Shaped Stone Structures, Ancient or Modern? *Man in the Northeast* 5: 60-61.

Hall, Robert L.
1997 *An Archaeology of the Soul*. University of Illinois Press, Champagne-Urbana IL.

Huntington, Frederick W.
1982 Preliminary Report on the Excavation of the Flagg Swamp Rockshelter. Institute For Conservation Archaeology, Harvard University, Cambridge, MA.

Jennings, Francis.
1975 *The Invasion of America.* W.W. Norton, New York.

Kehoe, Alice Beck
1998 *The Land of Prehistory.* Routledge and Kegan Paul, London and New York.

Krupp, Edwin C
1983 *Echoes of the Ancient Skies*. Oxford University Press, New York.

Leland, Charles
1884 *The Algonkian Legends of New England*. Houghton Mifflin, Boston MA.

Leonard, Kenneth C. Jr.
2002 *The Beechwood Confederacy, 1709-1809*. Heritage Books, Bowie, MD.

Lepore, Jill.
1998 *The Name of War.* Vintage Books, New York.

Leveillee, Alan.
2001 Personal Communication with Fred Martin, February 16.

Martin, F. W. And Martin E. F.
2006 A Midsummer Sunbeam Site in New England, in T. W. Bostwick and B. Bates, eds, *Oxford VII International Conference on Archaeoastronomy Flagstaff AZ, June 21-25*: 287-296.

Massachusetts Historical Commission
2003a September 17 Letter to Wluca Real Estate Corporation Re: King Philip Estates, Sharon MA (#Rc.27912).

2003b October 20 Letter to Frederick M. Martin Re: King Philip Estates.

Mavor, James W. Jr.
2002 The Sun Dagger at Table Rock Cave. *NEARA Journal* 39(2):43-48.

Mavor, James W. Jr., and Byron Dix
1989 *Manitou: The Sacred Landscape of New England's Native Civilization.* Inner Traditions International. Rochester, VT.

Neudorfer, Giovanna.
1979 *Vermont Stone Chambers* Vermont Historical Society. Montpelier, VT.

Nicolar, Joseph
1893 *Legends And Traditions of the Red Man*. Penobscot Nation, Old Town, ME.

Petersen, James B., Brian S. Robinson, et al.
1994 An Archaic and Woodland Period Fish Weir Complex in Central Maine. *Archaeology of Eastern North America* 22:197-222.

Pritchard, Evan T.
2002 *Native New Yorkers*. Council Oaks Books, San Francisco CA/Tulsa OK.

Reeves, Brian.
1994 Ninaistakis – The Nitsitapiis Sacred Mountain. In D.L. Carmichael et al., ed., *Sacred Sites, Sacred Places*. Routledge and Kegan Paul, London and New York.

Romain, W. F.
1992 Azimuths to the Otherworld: Astornomical Alignments of Hopewell Charnel Houses. *The Ohio Archaeologist* 42(4):42-48.

Rudolf, John H.
1998 An Ancient Solar Observatory at Willow Creek, California, in Daniel Gilmore and Linda McElroy, eds., *Across Before Columbus?* NEARA Publications, Ellsworth, ME. pp. 71-84.

Rustig, R
1988 *Tyendinaga Tales*. McGill University, Queen's University Press, Montreal.

Salisbury, Neal.
1982 *Manitou and Providence*. Oxford University Press, New York.

Schlesier, Karl H.
1987 *The Wolves Of Heaven*. University of Oklahoma Press, Norman OK.

Schoch, Robert M.
2001 Personal Communication with Fred Martin and Ted Ballard, June 22.

Simmons, William S.
1986 *Spirit of the New England Tribes*. University Press of New England, Hanover NH.

Snow, Dean R.
1980 *The Archaeology of New England*. Academic Press, San Diego, CA.

Speck, Frank G. and Jesse Moses
1945 *The Celestial Bear Comes Down to Earth: The Bear Sacrifice Ceremony of the Munsee–Mahican in Canada, as Related by Nekatcit. Scientific Publications* #7. Reading Public Museum and Art Gallery, Reading PA.

Stevenson, Matilda Cox
1901 *The Zuni Indians. 23rd Annual Report of the Bureau of American Ethnology*. Washington, DC.

Stewart-Smith, David.
2003a Personal Communication with Fred Martin and Ted Ballard, November 26.

2003b Letter to the Zoning Board of Appeals, Sharon, MA, December 2.

Thomas, David Hurst
1978 The Awful Truth About Statistics In Archaeology. *American Antiquity* 43(2):321-344.

Thompson, John
2000 Personal Communication with Fred Martin, December 13.

Towner, Clifford.
2004 Taped Personal Communication with Fred Martin and Ted Ballard, December 8.

Vandiver, Pam
1978 Personal Discussion with Jim Mavor when they were both faculty at MIT. (Vandiver is presently a Professor in the Materials Department at the University of Arizona.)

Volmar, Michael A.
1996 Maugua the Bear in New England Indian Mythology and Archaeology. *Bulletin of the Massachusetts Archaeological Society* 57 (2): 37-45.

Wade, C.R.
1976 *Indians, First Americans in Sharon Massachusetts: A History.* Sharon, MA Revolutionary Bicentennial Committee.

Williams, Roger
1643 *A Key into the Language of America.* Eds. John J. Teunissen and Evelyn J. Hinz. Wayne State University Press, Detroit MI.

Williams, Stephen
1991 *Fantastic Archaeology.* University of Pennsylvania Press, Philadelphia PA.

Winter, Eugene
2006 An Atlantic Phase Mortuary Feature at the Call Site, Billerica, MA. *Bulletin of the Massachusetts Archaeological Society* 67(2):42-47.

Wiseman, Frederick Matthew
2001 *The Voice of the Dawn*. University Press of New England, Hanover NH.

Identification and Preliminary Analysis of a Late Woodland Ceremonial Site in Southeastern Massachusetts

Kenneth C. Leonard, Jr.

Introduction

The evangelical goal of Plymouth Colony's theocratic Establishment was to eradicate the resident Native American cultures of this region. While the Pilgrims had preferred that the Indian vanish without a trace, from certain remote corners of their former colony probable remains of a number of the Natives' carefully constructed and serendipitously preserved religious sites have begun to reemerge. Almost exclusively these are appearing in areas not favored by the Establishment, but settled and held by colonial renegade dissenters for centuries. These sites, enhanced arrangements of natural objects, reveal a Native intellect, knowledge and harmony with his environment that considerably exceeded that of the

English. An example of the *genius loci* enjoyed by the Natives hereabouts is the subject of this paper.

Setting

In central southeastern Massachusetts, between the Taunton River and the Great Ponds Complex, lies one of the most impressive and extended granite bedrock outcrops in the Taunton River basin. While it originally lay entirely within Plymouth Colony, politically it now occupies parts of Plymouth and Bristol Counties as well as a bit of Rhode Island. Central to this geologic feature is over one square mile of contiguous exposed bedrock called "Rocky Woods", traditionally associated by both colonists and current-day locals with Indian activity (Delano 1934). On the periphery, at the larger outcrop's southeasterly end, in the 1980's, Mavor and Dix (1989:68-82) documented a number of lithic features thought to be of Native American origin. Recently, near the northerly end of this same outcropping, this author has found, and is continuing to find, a great number of additional lithic features. Many of these appear to be mutually associated and aligned not only with surrounding physical features, but with celestial objects and events as well. Their locations are entirely consistent with Bragdon's assertions concerning places customarily used by the Algonquians for rituals, "high places, swamps and nearby water"(Bragdon 1996:191-2).

Exposed bedrock scoring indicates that the most recent glacial ice flow was from the north-northwest (USGS Map I-742). Upland valleys and niches between outcroppings are literally cluttered with granite debris of all sizes, ranging from hand-sized stones to multi-ton chunks. Larger, deeper valleys have become swamps filled with meter-deep black muck. Between the outcroppings and the swamps lie hummocks of till and well differentiated deposits of sand and gravel. In particular, this site subtends two 20-acre kame terraces. Both lie on the north side of swamps. They are almost level and consist of nearly rock-free sand. One who is used to hiking in the area is immediately struck by the obvious lack of visible surface stone when crossing these terraces. Hence, the few surface stones that are visible tend to stand out, and any pattern they may have is made more obvious.

This site lies within an area known in early colonial times as "the Great Plain". It was overlooked by "Great Plain Hill", a smooth, rounded deposit of glacial till just to its northwest (Middleboro Proprietors Records (MPR): 350, 482). These references to a "plain" are unique in these records and strongly imply that the area was largely clear of trees when first surveyed. It is centrally located in the so-called Sixteen Shilling Purchase. This purchase is unique in that it conveyed the last large piece (42 sq. mi.) of Wampanoag land into the hands of the English a scant four weeks before King Philip's War broke out in 1675. Land containing this site was first laid out in 1706 by Jacob Tomson, Middleboro's surveyor, who personally wrote out the descriptive Proprietors Records referenced above. The land was purchased by homesteaders and originally settled between 1714 and 1735. Significantly, settlers in this part of Middleboro were nearly all dissenters. Originally Quakers, they had largely become Baptists by the time of the Revolution. They all came from just five families who never moved away and consistently intermarried well into the 19th century. Consequently, it was the estate of the childless widow of the great-grandson of the original settler who sold over 100 contiguous acres containing most of the site to the father of the present owner ca 1940. As it descended through its three centuries of closely held ownership, bounds were infrequently redrawn. The most recent change occurred in 1836. Overall, we may conclude site integrity has been remarkably well preserved. Its most fragile and delicate artifacts lie in what its early owners called "their upland meadow" (Leonard 2003:1-101, 130-2, 212-3).

The discovery of these latter features obtained from a comprehensive survey of existing stone walls undertaken by the author ca 1990. It was immediately obvious that the stone structures in the subject area were quite unlike the stone walls standing elsewhere. Then, in 2001, a selective timber harvest revealed a few large, isolated boulders, all of which seemed to lie at cardinal points relative to the structures. When it was found that the structures lay closely aligned with true North, serious analysis commenced and the scope of the site slowly emerged.

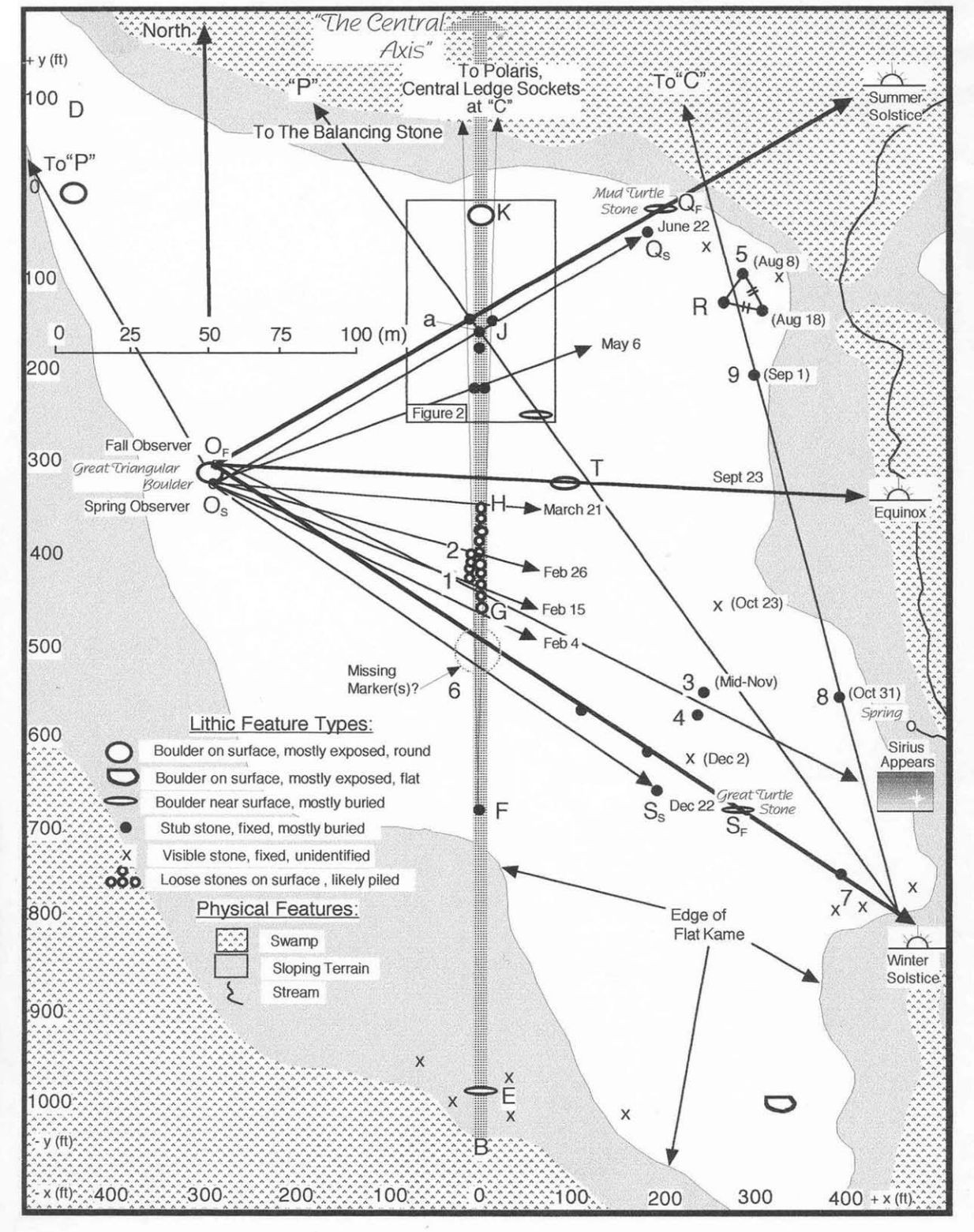


Figure 1: Schematic Map of the Main Axis, Lakeville Site. Plan by K. Leonard.

Observation Techniques

The relative locations and orientations of all lithic features found, discussed and plotted on the maps which follow have been determined using standard surveying technique and equipment. A calibrated one-minute optical transit (David White Path TR-300) and a 300 ft. fiberglass tape with decimal scale were used for all work except for the two over-water legs where a high accuracy (Leitz) laser transit was substituted. This reduced the likelihood of introducing range errors measuring with tape in difficult terrain.

True North was determined over an eight-month period by averaging multiple independent observations with the optical transit of both the upper and lower culminations of Polaris (Sinnott 2001, 2002). All sightings were made from a single point and dropped directly onto a terrestrial line some 500 ft. (150 m) long that runs across a flat, open field.

All measurements were made to the apparent centers of features. Angles were recorded to one arc minute. Ranges were taken to the tenth foot. English units, customary in surveying, were retained in the trigonometric equations used to reduce the data, and in the plotting of it. Only for the scales in the Figures and for numbers in the final text have metric conversions been introduced for the readers' convenience. Trigonometric checks performed in the almost completely surveyed southern part of the site reveal that overall accuracies of about two arc minutes and 2.4 in. (6 cm) were achieved.

In order to circumvent the obscuration of events by the trees now present on the site, azimuths of celestial objects appearing at the horizon were calculated using classical navigation methods. For the mathematically inclined, the Appendix details how this was done.

The maps, Figures 1, 3, and 5, are for illustrative purposes only. Features, when they are first referenced in one of the Figures, are designated by upper case letters, lower case letters, and numbers, respectively, which designations they retain when they reappear in any subsequent Figure. The size of this site precludes plotting its features accurately enough on a page-sized sheet of paper to evaluate their alignments conclusively. Although the surveyed positions have been plotted as accurately as possible and a reasonable overview of their relative locations shown, the reader is cautioned from drawing further conclusions without referring back to the mathematics. Further, the physical features, swamps, hills and streams, have only been sketched in and are intended solely to give a relevant environmental context for the features. Likewise, the old stone walls, shown in Figure 1, have not been newly surveyed, but transposed from existing maps with particular care to preserve their exact orientations. This tends to illustrate their divergences in bearing from the subject features.

Part I: The Site

While the author has simplified the following descriptions to the best of his ability, the site itself remains a very complex structure and a casual reader's dismay is still nearly assured. The serious reader is strongly encouraged to make continuous reference to the maps as features are mentioned and described, possibly to the point of making detached copies of them for more handy examination. A slow, deliberate and, as necessary, repetitive reading will hopefully reveal the true elegance of design that is present.

A Central Axis

The overall arrangement of features appears to be generally centered on a central axis. As shown in Figure 1, this axis is over 3500 feet (1070 m) long and is closely aligned with the earth's axis of rotation. Its northerly, higher end, A, apparently terminates hard by bare granite bedrock, while its lower, southerly end, B, meets the edge of an extensive, 1000-acre cedar swamp known as Hunting House Swamp to the colonials. Its southerly portion crosses an oblong, 20-acre kame terrace which juts well out into the great swamp with access over a narrow isthmus, D, of high ground. Projecting northward from the terrace, it leaps a tongue of the swamp, proceeds across a gently sloping upland, and on up to an impressive central granite outcropping, C. From there it proceeds northward across Spring Brook and upward towards the northerly ledge.

Beginning at its southerly end where the axis meets the swamp, on a lower sub-terrace nearly at swamp level, it crosses a mostly buried conglomerate boulder, E. At the crest of the rise from the swamp it encounters a small stub stone, F, that will be discussed further below. From thence, it runs across the flat kame terrace where it intersects a centrally located feature.

The "Tuning Fork" (Figure 2)

Between G and H one finds two curious rows of stones lying piled northward along the axis. The sheer number of stones forming them suggests material must have been brought considerable distances for this purpose, given the otherwise nearly rock-free nature of this terrain. From its starting point, G, the first uniform stone row runs along the axis for 121 feet (36.9 m). It then abruptly stops at H. However, 29.5 feet (9.0 m) north of the starting point of this first row, the second stone row commences. The second row has been placed about nine feet (2.8 m) to the west and runs parallel to the longer row 25.5 feet (7.8 m) before apparently ending or merging with it. The overall pattern resembles a huge tuning fork with one short tine.

Figure 2: The Tuning Fork, Facing South, Features H-G on Map 1. Photo by Paul Ziobro.

124.2 feet (37.9 m) to the north of the tuning fork the axis encounters an elaborate array of stub stones, J, centered some 1300 feet (396 m) south of the central ledge, a number of which lie directly on the axis. This feature will also be discussed below. As the axis leaves the northerly edge of the terrace, an isolated large granite boulder, K, clearly marks its path.

Upland Features

A collection of stones, L, surrounds the spot where the axis again touches upland across the swamp. A recessed, shelf-like feature in an exposed bedrock ledge marks its center point, C. This niche has a flat bottom measuring three by four feet. Equidistant from it, exactly 57 feet (17.4 m) to the northeast and northwest lie two smaller, complementary niches. These are about one-half the size of the central one. The easterly one, C_E, resembles the central feature being shelf-like in appearance, while the one to the west, C_W, appears to be a socket-like excavation about 20 inches (50 cm) deep near the center of a dome-shaped piece of the outcrop. To infer that three standing stones once occupied these well exposed receptacles seems appropriate, particularly since a pointed stone over six feet (2m) in length whose base appears to fit the westerly excavation still lies nearby.

From the central ledge, the axis continues northward across a substantial brook and up onto another kame deposit. Again, stones mark the intercept at M. These strongly resemble a ruined cairn next to a nearly buried boulder. Both lie directly on the axis. This terrace's flat top contains at least another 20 acres of smooth, nearly rock-free ground. The northerly edge of its surface abuts another impressive granite outcropping, N, which lies 1300 feet (396 m) north of the central ledge. This outcropping is about 10 feet (3m) higher than the central ledge which, in turn is about 10 feet higher than the south terrace in the swamp. Without trees, end-to-end line-of-sight is assured. This northerly outcropping is dramatic. Its distance from C dimensionally mirrors that to the stub stone array at J on the south terrace. And, it features an overlooking dais-like formation at its southerly tip, a "speaking platform" from which an orator could today comfortably address several thousand people assembled upon the smooth kame to its south (Solomon 2004).

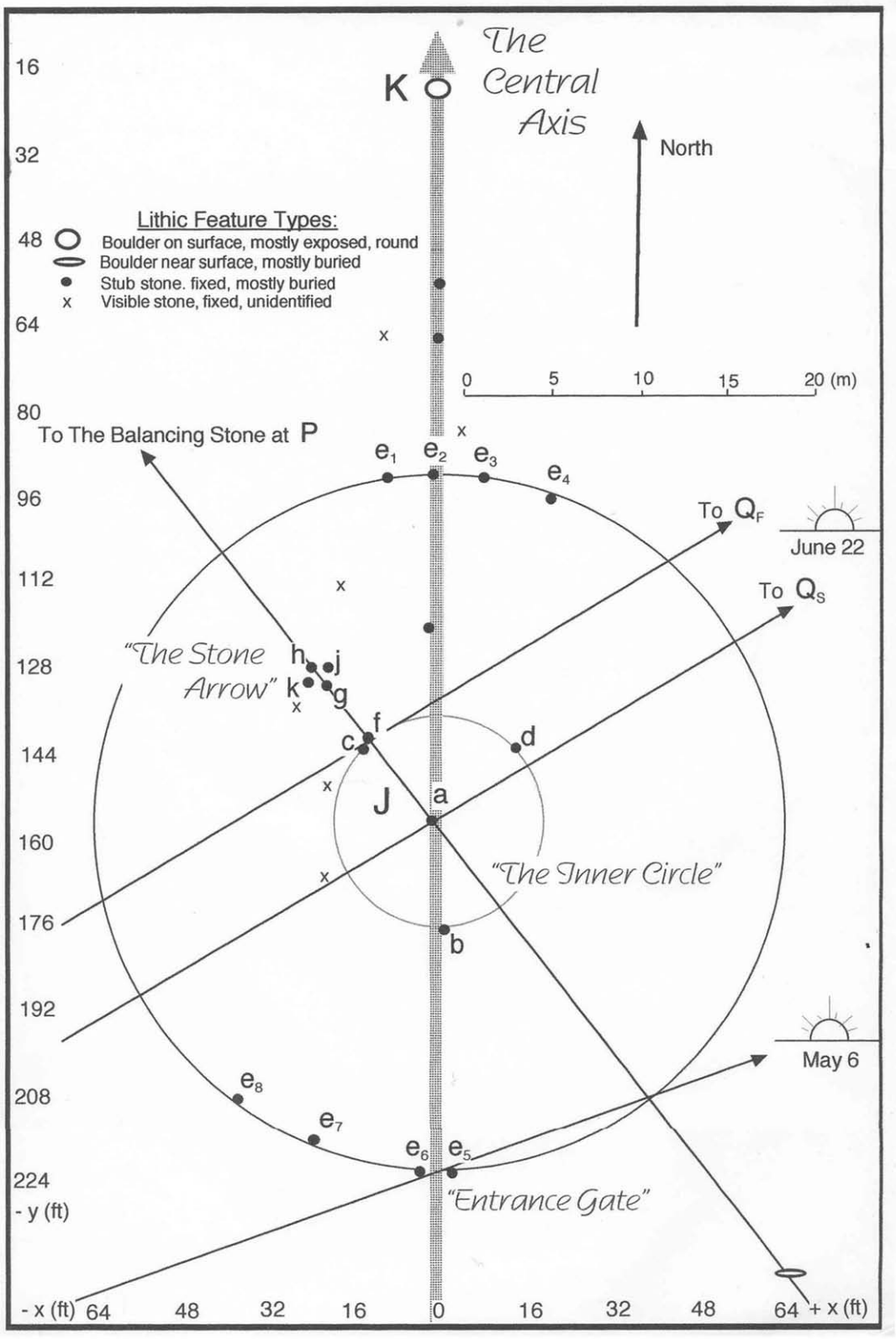


Figure 3: Map of the Calendar Circle, Lakeville Site. Plan by K. Leonard.

A Calendar ??

Returning to the south kame terrace to examine some features that lie away from the central axis, 300 feet (90 m) to the west of it stands a singularly large, isolated, triangular boulder, O, of sedimentary stone. It is nearly due west of the north end of the Tuning Fork, H. From O an observer can view each and every sunrise of the year directly over the central axis as they cycle back and forth from solstice to solstice. From this spot also a hand-held compass strongly suggests that the equinox sunrises will occur very close to the north end of the Tuning Fork. And, a simple calculation using equation (1) from the Appendix reveals that the Summer Solstice sunrise will occur directly over the considerable collection of stub stones, J, mentioned above, that lie on the axis 1300 feet south of the central ledge. A detailed drawing of this complex feature appears as Figure 5.

The Summer Solstice

Examination of the axis at J reveals that a single stub stone, a, marks where the calculated Summer Solstice sunrise line crosses it. 20.1 feet (6.1 m) to the south, directly on the central axis, lies another stub stone, b. To the northwest and northeast of the central stone, again exactly 20.1 feet away, two "quarter-stones", c and d respectively, have been placed some 26 feet (7.9 m) apart. To many who have seen them, these four markers suggest a circle 40 feet (12.2 m) in diameter. This suggestion is reinforced by an even stronger indication of an outer, concentric circle whose radius is 63 feet (14.3 m). It seems to have at least eight stub stones, $e_{1\text{-}8}$, marking its circumference. These appear to have been preferentially placed near the central axis, and two of them, e_5 and e_6, essentially frame the axis's entrance to this unique area from the south.

Figure 4: The Balancing Stone, Figure P on Map 1. Photo by Paul Ziobro.

To the northwest, about 16 feet (5 m) beyond our putative inner circle, along the extension of a radius drawn from its center, a, through a stub stone on its circumference, f, four additional rocks have been placed. The first two, g and h, lie about five feet (1.5 m) apart on the radius line, a-f, while the other two, j and k, have been put about two feet (65 cm) to either side, in just a bit closer to the circle from f. Taken together the set makes the obvious shape of an arrow. A little over one-half mile (800 m) away, in the exact direction of its pointing lies a spectacular perched boulder, P.

The Balancing Stone (Figure 4)

This huge rock, situated in light woods some 1970 feet (600 m) west of the central axis, sits on an exposed hillside not far off a neighborhood road. Locals call it "The Balancing Stone". It is sedimentary, ovoid in shape, 7-9 feet (2-3 m) in diameter, and weighs about 40 tons. While precariously perched atop three slender bedrock prongs, it has apparently been chocked in place by a fourth stone to prevent any rocking motion. Without intervening trees it would be visible from virtually anywhere on the site.

In treeless terrain, the Balancing Stone would have direct line-of-sight to the speaking platform, N, and lies due west of it. This suggests strong equinox connections. In addition, it is collinear with the central and westerly sockets, C & C_W, on the central ledge, such that from the Balancing Stone, P, their presumed standing stones would appear as one, silhou-

etted against the rising Winter Solstice sun, which comes up over a very prominent high ledge on the horizon two miles (3.2 km) distant. And, for the sunrise observer on the south kame terrace standing at the triangular boulder, O, when he turns to the northwest, the Balancing Stone at P stands perpendicular to the summer solstice line, O - Q, and is designated by the apex of the triangular rock.

Easterly Features

Returning to the area J, where concentric circles apparently mark the central axis, and over which the Summer Solstice sunrise is seen, and from thence proceeding eastward to the edge of the terrace along the sunrise line, O - J , we find that two additional stones apparently mark the Summer Solstice sunrise as well. One of them, Q_F, is substantial. A large sedimentary boulder about two by four feet (60 by 120 cm) in size, it resembles a huge mud turtle perched on the very edge of the terrace (Solomon 2003). The other marker, Q_S, appears to be a typical stub stone resembling the ones back near the axis.

Southward from there, and again at the edge of the terrace, directly in line with the southerly, outer limb of the concentric circle formation on the central axis at J, lies another configuration of stub stones, R. Three of them form a perfect isosceles triangle laid out with equal 42-foot (12.8 m) sides running northwesterly. These stones may be associated with a fourth that lies a bit to the east. If this is the case, a circle would better describe the feature. This area lies on the very rim of the terrace and overlooks a small, but most attractive clear, spring-fed stream.

These first described easterly features, Q and R, are equidistant, some 600 feet (180 m) from the triangular boulder, O. When one follows the so-defined semicircular path to the south, little else of size catches the eye before reaching a point where the Winter Solstice sunrise would appear to the observer at the triangular boulder. However, there is a single, now crumbling, large, sedimentary stone, T, set well back towards the axis where it sits almost at the center of the terrace. It lies on the Equinox sunrise line.

The Winter Solstice

Unlike the Summer Solstice, the Winter Solstice seems not to have been marked directly on the central axis, but the gigantic, sedimentary stub stone, SF, found on the 600-foot (180 m) semicircle at the correct bearing is a truly impressive object. Oval and smooth like the Summer Solstice stone but larger, it, too, resembles a great turtle (Solomon 2003), this one some three by five feet (1 x 1.5 m) in size. This stone is the largest to be found on the terrace. Nearby lies a companion stub stone, SS, of typical size, comparably located to the similar one, Q_S, found near the summer solstice turtle stone.

Moving due west from this area back to the central axis, we encounter the first stub stone, F, mentioned as we ascended from swamp level and reached the flat terrace. From this unique point the two outer sockets in the central ledge, C_W and C_E, appear to align with the two stub stones, c and d, on the inner circle at J. Survey data indicate that this alignment is sufficiently accurate to appear perfect to the naked eye.

This overall arrangement suggests unification of the central ledge with the south kame terrace. In addition, the Equinox lines and the solstice turtle-stone markers form an apparent outline of the solar year. Therefore, in the next section, we shall apply some more powerful mathematical techniques that will strengthen our contention that these features, and others present, are probably related.

Part II: Interpretation

Before proceeding, the serious reader is asked to step back and reflect upon the overarching harmonies that characterize the site, and to crystallize a vision of it in his mind's eye . . . .

. . . . So armed, the following detail will, hopefully, be better and more readily appreciated. Nonetheless, as before, ongoing frequent reference to the maps and figures is encouraged.

Analysis Techniques

There are a number of possible associations among the various lithic features described above that are suggested by their mutual alignments and orientation to celestial events. These putative relationships were next tested by placing terrestrial objects of in-

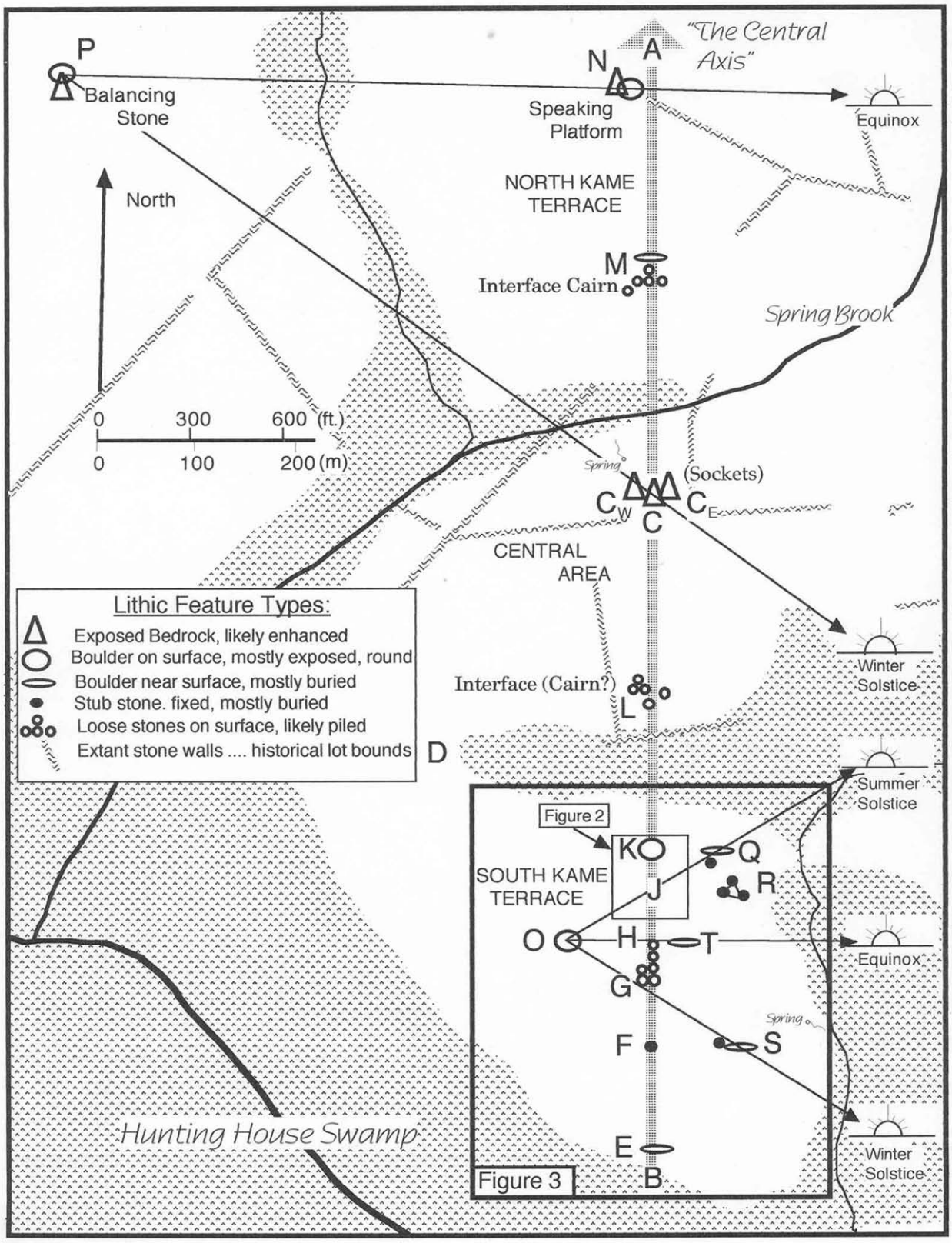


Figure 5: Schematic Map Showing the Positions of Key Observers, Lakeville Site. Plan by K. Leonard.

terest in a Cartesian (x, y) coordinate system and representing postulated straight lines amongst them using analytic geometry. A generalized method was used which allowed multiple points to be evaluated simultaneously and determine a best fit to the geometry. The Appendix describes this method in detail. The residuals calculated by this approach were examined statistically to measure how much they scatter. This suggests in some measure how accurate the whole process has been and how precisely the markers may have been placed. Residuals (errors) of this kind are distributed normally, i.e. according to the familiar bell-curve, just as are, supposedly, students' grades. This distribution is characterized by its standard deviation, σ, which essentially defines how spread-out things are. Specifically, about two-thirds of the data have values less than σ.

Results

Application of these techniques to the survey data has provided considerable insight and suggests several probable ways in which the site was used. One of the early and most interesting indications was that while the great triangular boulder, O, surely designated the observation station, there were most likely two separate observers involved. (Please refer to Figure 5.) One stood a few paces to the north of the boulder, the other a few paces to the south. Further, the northerly observer, O_N, apparently generally used larger, boulder-sized stones beyond the axis as horizon markers, while the southerly observer, O_S, used diminutive stub stones, most of which lay directly on the central axis. Significantly, the locations of their observation points, some 26 feet (8 m) apart, exhibit standard deviations of a mere five and three inches respectively, as will be shown below. Both uncertainties fall well within the sizes of the stones used for horizon markers. The reader should further bear in mind that for these observers, the limiting resolution of their vision, (20/20 assumed), would be about one inch (25 mm) at the central axis, and about 2 inches (50 mm) at the edge of the terrace. In short, it appears that the two sets of horizon markers were located with accuracies approaching the limits achievable with unaided eyes.

Algonquian Insights

If the reader can accept the observations and probable associations between various objects on the site that were described in the first part of this paper, a considerable number of initial conclusions can be drawn about how the annual Algonquian ceremonial cycles were likely regulated and observed. Nonetheless, the author wishes to emphasize that his work to date must be understood as preliminary. Discovery and analysis are ongoing. There is ever-increasing evidence that the subject site contains multiple 'layers' of sometimes overlapping features that appear to have been added sequentially. Such timing issues will be addressed below.

The Cosmic Axis

This arrangement of features appears to be, in part, a replica of the Algonquian Cosmic Axis which traditionally connected the three realms of their universe: the heavens, the earth and the under(water) world (Bragdon 1996:185). The site strongly suggests Bragdon's tripartite Algonquian universe where the great swamp represents the underworld, the isolated island-like terrace, the earth and the upland, the heavens. In addition, this Cosmic Axis, our central axis, appears to be clearly marked at each of its interface points where it enters or leaves one of the realms. Just as it rises from the great swamp it crosses the large conglomerate boulder, E, located on a low terrace which also contains a few stub stones near its periphery. A small ceremonial area is suggested. As the Axis leaves the south kame terrace it crosses the equally large, round, granite boulder on the surface, K. Where it again touches upland, a very considerable number of loose stones lie scattered about which suggest a ruined cairn, L. At its center stands the high ledge, C, with its putative standing stones, coincidentally also aligned with the Balancing Stone, P, and the Winter Solstice sunrise. Such standing stones' visibility from the terrace would be dramatic, and their iconic piercing of the heavenly realm entirely consistent with the symbolism of the Cosmic Axis (Cook 1974:7). From C the Axis runs directly off the top of a cliff shortly to cross over a small swampy area and substantial brook before touching upland again on the north kame terrace. The spot where it first touches level ground is clearly marked by a buried boulder and cairn. Significantly, all these intercept markers are consistent with the Cosmic Axis interface features mentioned by Bragdon.

The Calendar

The earthly realm, possibly embodied by the south kame terrace, some 25 feet (8 m) above the swamp, detailed on Figure 3, hosts a panoply of lithic features apparently arranged to meet and interact with sunrise on the days of their relevancy. Such cyclic motion and annual repetition embodied the very essence of time for the Algonquian (Bragdon 1996:221-2). Some dates are apparently marked at sunrise by mostly buried stub stones some 300 feet (90 m) east of the Axis. Others are marked directly upon the Axis itself. These dimensions suggest strong anthropometric harmonies. A human figure (six feet (185 cm) tall) with outstretched arms (six feet wide) standing back-lit by the rising sun at one of the distant stub stones almost exactly subtends the diameter of the sun (one-half degree) for an observer at the westerly boulder, O. And, during most of the year, day-to-day movement of the sunrise along the central axis can be approximated by a line of persons standing shoulder to shoulder atop it. On successive days, the sunrise would appear to move from one person to the next on down the line suggesting the human figure, quite possibly holding a vertical staff as an exact sighting reference tool, played some role in the sunrise ritual. With the exception of three to four days around each solstice, any single day, or span of days, can be unambiguously designated.

Fine Tuning

Important time intervals seem to have been denoted by heaping easily transported rocks onto the ground along the Axis. These form linear, mounded rows that present a totally different character, texture and appearance from the local colonial walls. Their precise linear alignment, similar in form to a tuning fork, was discussed above. This arrangement was most likely achieved by the simple method of first viewing the boulder, K, on the northerly rim of the kame terrace against the pattern of standing stones on the ledge at C some 1500 feet (460 m) away, shifting back and forth until they lined up, and then putting down each rock.

The fourth of February is usually the day halfway between the Winter Solstice and the Vernal Equinox. The former event is marked by the southerly end, G, of the first mound of stones piled northward along the central axis. From its starting point this uniform stone row continues for 121 feet (36.9 m) until the point, H, is reached where the Equinox is observed 44 days later. However, a bit later in February, beginning 11 days after the first, the second stone row commences at 1. As mentioned, this second mound has been placed about nine feet (2.8 m) closer to the observer at O and runs parallel to the longer row for another 11 days, about 25 feet (7.75 m), before ending at 2.

These 11-day intervals are highly significant. Eleven days denotes the difference between the length of the solar year and 12 lunations. This difference can be used to decide, well in advance, when a leap (13th) month is needed to reconcile one's solar and lunar calendars. (It becomes extremely ungainly to just declare arbitrarily that the solar year has either just 12 or 13 moons and try to perpetuate this. Things go badly amiss very rapidly.) The Jews abandoned direct use of this hands-on approach and adopted a rote system based on the 19-year Metonic cycle in the fourth century (Spier 1996:6). The Chinese still employ a rule that says if there is a new moon within the 11 days immediately following the winter solstice, a leap month is due in the modern Chinese calendar (Aslaksen 2002:10). This happens every two or three years. Nor was the 11-day difference unknown elsewhere in Native North America. The Pawnee Chart of the Heavens clearly depicts a crescent moon whose age is exactly 11 days short of full and the Chart appears to be a drawing of conditions they believed to obtain shortly before their Creation (Leonard 1987: 85-6).

In our application at this site, during the first 11-day interval (Feb. 4-15), if upon sighting the sunrise, the observer turns around and sees that the moon is just (past) full by simply noting it has not yet set, (and, we have documented evidence from Roger Williams writing in 1642 that these people "measured the moon by the setting of it" (Williams 1973 [1643]:155)), he knows immediately next year will be a leap year and contain 13 new moons. If the moon becomes full later as the sun rises over the doubled mound, two years hence will contain the extra moon. This remarkable result is made possible by recognizing that the 44-day interval between the seasonal midpoint in early February and the Equinox is, uniquely, very nearly sesquisynodic (the precise number be-

ing 44 days, 3 hours and 33 minutes (Allen 1955: 20)). Hence, it relates the time of the observable full moon to that of the invisible new.

A New Year's Sunrise Gate

Reliable solar calendars also require reconciliation to bring the actual 365.2422-day long year into an integral number of days, 365 or 366. At first glance, casual use of this site would have automatically inserted an extra day about every four years as one awaited the sun's arrival at some specific marker, and all would be well. However, the elegance of the site would seem to rule out such casual use. Every passing day was counted and undoubtedly the 365-day year was a known quantity. Consequently, introduction of the occasional 366th day surely would have been an event to be observed at a special time.

Local Algonquians still celebrate their New Year in the first week of May. Their published tribal calendar runs from May through April (Champlain 2003). The sixth of May marks the midpoint between the Vernal Equinox and the Summer Solstice. Twin stones, e_5 and e_6, spaced a day apart, as viewed by the sunrise observer at O_S, stand to either side of the axis marking this day. This is the only instance known to the author where a single day's interval is lithically shown. To infer these two stones form a sunrise gate that the sun must enter for the New Year to commence seems reasonable, and, occasionally waiting an extra day for it to happen would correctly insert a leap-day as needed. This apparent gateway also suggests an earthly entrance to the circular area, J, a center of likely ceremonial activity. Curiously, and perhaps significantly, this date's sunrise lies the same distance to the north of the equinox line as the start of the Tuning Fork lies to its south. A symbolic linking by symmetry of these two critical calendrical reconciliations is easily inferred.

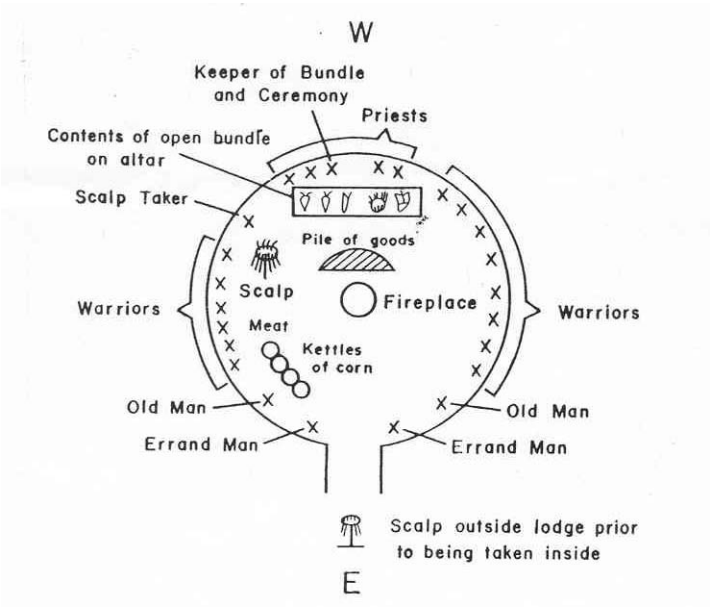


Figure 6: Chart of the Pawnee Ceremonial Lodge (after Murie 1981)

New Year rituals may also have involved use of the area, R, on the same sunrise line, O - $e_{5\text{-}6}$, which contains the 42-foot isosceles triangle. The stream below it is still regularly embellished at this time of year by an attractive display of wildflowers. The coincidence of this date with the annual peak flowering down by the stream is noteworthy. It is consistent with modern Native tradition (Wixon 2002) and may well reflect careful selection and design of the site.

Summer Solstice Ceremonies

Bragdon and others indicate the Summer Solstice marks one of the important balance points in the Algonquian annual cycle when the opposing forces of death and renewal are equal (Bragdon 1996: 222). It is still locally celebrated. Ancient observers, watching the rising sun trek north along the central axis, then seeing it slow, and slow some more, finally to stop, hesitate for three days, and then slowly begin to creep back southward, experienced a dramatic event indeed. So dramatic that our evidence suggests some very considerable and elaborate collateral rituals were apparently performed. Back on the central axis at J lies the compact arrangement of relatively small, but clearly very carefully placed rocks that were shown in Figure 3. This one area of the south kame terrace is noticeably more densely arranged with stub stones than any other which, in itself, suggests it may have been a center for celebration and ritual. It clearly resembles the very consistent floor plan of the Pawnee ceremonial lodge. Our area differs only that it faces south instead of east in the case of the Pawnee (Murie 1981 [1921]: 59, 73, 137, 144, 145, 146). An example taken from Murie's work is shown in Figure 6. Comparison with Figure 3 suggests that the placement of some stub stones may have been intended to ensure the correct performance of ritual.

In addition, the radii of these concentric circles may have had choreographic significance. They appear to have been drawn in the ratio of π. That is, a line of equally spaced dancers in traditional formation (Champlain 2003: cover) along the central axis, or any other diameter of the outer circle, would, upon filing inward, perfectly fill the circumference of the inner circle (Ellfeldt 1967: 14-5) with no change in spacing. The author observes that similar movements and phrases frequently appear in very effective contemporary dance routines (Minton 1997: 45). The Balancing Stone, P, being designated by "the Stone Arrow", appears clearly linked to activity in this area, and it is easy to imagine that it was used in solstitial ceremonies, particularly during the sun's four-day hesitation as a cyclic icon linking earth and sky (Bragdon 1996: 231). Visible from anywhere on the calendar site, this object may have been central to a number of the annual ceremonies. Quite possibly it served as a signaling device used to convey the very moment of significant events to others outside the area. A far smaller (table-sized) rocking stone, similarly perched on bedrock, was recently shown by experiment to be audible some two miles distant (Mavor 2003).

A Pole Star Connection

The inner circle at J and central ledge markers at C, whose probable association has already been established, may be related to the daily motion of the heavens. For an observer standing in the summer solstice circle at a, Polaris, the North Star, appears over the central ledge some 1300 feet (396m) away. Once a year, at the end of January for about a week, the observer can watch the Pole Star trace its entire descending semicircle in the sky. From its upper culmination seen in evening twilight it reaches western elongation around midnight before looping downwards and eastwards to reach lower culmination at dawn. Significantly, its complementary ascending, easterly semicircle can never be continuously observed. Summer nights are far too short.

The outer sockets on the ledge could well have marked this continuously visible western excursion and then the Cosmic Axis replica was placed between them. While there appears to be no direct evidence in the Algonquian record, the delineation, graphic representation, and naming of the "hole" or zone of darkness (starless sky) around the north celestial pole were practiced by other North American tribes. e.g. ,"The Big Black Meteoric Star" of the Pawnee (Murie 1981 [1921]:34,39) (Leonard 1987:83-4) and the Hurons' hole in the sky (de Brébeuf 1898 [1636]:125-6). For the observer at a (Figure 3), the easterly socket, C_E (Figure 1), stands at true north and the westerly one, C_W, aligns with a location just to the east of the speaking platform, N. If this separation truly represents an observed excursion of Polaris, standard precession tables (Allen 1955: 278) indicate that the arrangement of sockets and putative standing stones on the central ledge was laid out about 1250 C.E. (750 B.P.), ±10 yrs.(1s).

There are several incompletely surveyed stub stone arrangements on the north kame terrace that apparently align with this same location just east of the speaking platform. Examination of the designated area reveals several table-sized fragments of granite, a number of which look to have been worked. Conversely, if the westerly elongation of Polaris was originally viewed over the speaking platform itself, that event would have occurred 100 years earlier, about 1150 C.E. These dates agree well with the ^{14}C dates, 1100-1200 C.E., recorded at a probable Native American site just five miles (8 km) to the south on this same granite outcropping (Mavor and Dix 1989:72). Taken together, this could suggest we are seeing a period of construction that lasted a century or longer and that it occurred during the era when Native dependence on agriculture was rapidly increasing (Snow 1980).

Returning to the point of observation, a, it appears that first the size of the inner circle was determined by rendering it tangent to the autumnal observer's sunrise line, O_F - Q_F (Figure 5). Then, its quarter-stones were positioned. One individual proceeded down the central axis to the stub stone at point F. From this spot on the southerly edge of the flat observation area again the central ledge at C was sighted. Looking northward, two quarter-stone holders on the circle were directed to stand in line with the outer markers on the central ledge, C_W and C_E, and when they appeared to be aligned, the stones were put down at c and d. That their present accuracy of

alignment would, without trees, still appear perfect to the unaided human eye is verified by our survey. It is good to 0.1 ft. (3 cm).

For this same observer at F, another startling perspective would have presented itself as he gazed northward. Three companions, the first standing at J in the inner circle, the second on the central ledge at C, and the third atop the far speaking platform at N, would all appear equally spaced and in a perfectly straight line, side by side. Their heads would seem to be at the same height, but their size would decrease in equal steps, with the stature of each diminished to exactly one-half that of his companion to the right, demonstrating another anthropometric harmony of site design.

Ritual Implications

The features suggest that a two-person team made the daily sunrise observation. The actual sunrise observer stood at the triangular boulder while his companion stood off to the east to mark the horizon where the sun came up. It appears the latter's station was, consistently, either directly on the Cosmic Axis, or almost exactly twice as far away, near the easterly edge of the terrace. We suggest further, there were at least two such teams that worked in six-month shifts. It was apparently during the three- to four-day periods as the sun remained stationary at the solstices when observer teams were exchanged. This semi-annual transition seems to have occurred with both teams in the field, and when the companions were at their respective posts back near the easterly edge of the terrace. Starting at the winter solstice, shortly after the exchange, with the springtime observer in place at O_S, his companion apparently moved back to the axis when the sun started to move northward. Taken as a set over the next six-month period, his eight currently identified springtime event markers, S_S, G, 1, 2, H, e_e, a, and Q_S (Figure 3) have a standard deviation of about three inches (8 cm), quite a bit smaller than the size of the stones being used. At the end of this six-month period when he reached point, he would move back along the sunrise line to Q_S, and sometime before the sun started back southward, the other team would be fielded and a transition back to observer O_F and companion Q_F would occur. The Pawnee accomplished a comparable semi-annual rotation of their four Leading Bundles which together defined for them a two-year ceremonial cycle (Murie 1981 [1921]: 34, 72-5). Details of any similar transition ceremony for the Algonquian are not extant, although clearly, redundant stub stones have been set.

After the June transition, through the summer and fall, the observer's companion apparently traced a separate pattern of stub stones set back near the easterly edge of the terrace. These describe the semi-circular path back to the Winter Solstice markers shown in Figure 5. Although interim events and ceremonies during the fall have yet to be identified, three sure points, the two very massive markers for the solstices, S_F & Q_F, and the large Equinox stone, T, exhibit the aforementioned standard deviation of only five inches (13 cm), which is still very small, considering the three- to five-foot (1-1.5 m) boulders used to mark the events.

As the sun picked up speed on its journey south and high summer approached, towards the end of July, Sirius made its annual reappearance through early morning twilight low in the southeast. This event would have been visible to the sunrise observer about 35 minutes before sunrise directly above the two closely spaced stones, 3 and 4, shown in Figure 5. (Alternatively, these same stones can designate mid-November sunrises.) The actual date of Sirius's reappearance is not constant. Due to precession it moves forward slightly more than one day per century (Allen 1955: 230, 278). (Currently it reappears on or about August 13th, depending upon atmospheric conditions.) Therefore, it may well not have been marked as a fixed date on the annual sunrise calendar. Given the accuracy of this site's layout, precession would have been discovered within three generations. Nonetheless, it seems fitting to recognize the cyclic renewal of the sidereal year and Sirius, the brightest star in the sky, is a common choice.

In early August the rising sun again reached stone configuration R, with its putative ceremonial area, overlooking the little stream. Stone 5, also labeled "Aug 8" in Figure 3, may mark summer's mid-point, but its (large) residual of 18 in (50 cm) does not make this conclusive. Nonetheless, now it was time to be-

gin the harvest. Again it seems likely for a week or more, as the sun appeared daily behind the ceremonial area, festivities would have been held before the celebrants had to join the harvest in earnest (Simmons 1986:45). Overall, the duration and dates of this mid-summer's event suggest it may actually have been the oft-reported but elusive Keesaqunnamun festival (Bragdon 1996: 227).

The Winter Solstice may never have been marked directly on the central axis, near 6, or its marker may have been sufficiently dramatic (a standing stone?) to have drawn the colonists' attention and it was destroyed. However, the remaining very large sedimentary stub stone, S_F, on the 600-foot (180 m) outer semicircle is a truly impressive object. Its nearby counterpart, S_S, for the springtime observer's companion appears almost trivial in comparison. Nonetheless, their combined presence supports the notion of a semi-annual transition of observer teams taking place.

Beyond the great turtle stone eastwards along the sunrise line, O_F - S_F, just as it nears the edge of the terrace, on a small peninsula there stands another recently discovered arrangement of stub stones, 7. From here the Balancing Stone, P, appears directly behind and above feature J on the central axis. This rather neatly co-joins the two solstices iconically. And, from this same spot, the observer sees the central ledge, C, over two, evenly spaced stub stones, 8 and 9, that coincidentally align with ceremonial area R. The isolated, scenic setting of this peninsula with its apex-like overlay of alignments strongly suggests some, as yet undiscovered, ritual relationship (Solomon 2004).

Summary

It will probably remain substantially impossible ever to "prove" that this site is Native American in origin. At present we have, at best, a reasonably convincing case based on circumstantial evidence. The wilderness area where the site lies was retained by the Natives longer than any other in the region (Leonard 2003). The colonial record implies it was relatively free of trees in 1706 (MPR). The area has been traditionally associated with Native American activity from colonial times right up through the 19th century (Delano 1934; L. Leonard 2005). Detailed examinations of the site and surrounding areas have been made by responsible representatives of the Narragansett (Seketau 2003), Wampanoag (Wixon 2002, Blake 2003), and Massachusett (Solomon 2003, 2004). All unanimously agree that a wide variety of features found hereabouts are wholly consistent with current Native knowledge of what traditional ceremonial sites are thought to have looked like. These features are very inconsistent with either Contact- or Colonial-period European constructs. A generation or more of astronomical observation from the site itself would have been necessary to develop the alignments now found here, a period far longer then any Contact-period visitor could have afforded. There is no evidence that European colonists coordinated any of their activities with celestial events. In fact, the official calendars used in England at this time were some three weeks (early) out of alignment with the seasons. Nor were colonists wont to align their structures with natural landscape features, to say nothing of correcting their carefully surveyed land boundary bearings to true north (the earth's axis) so they would not vary from one decade to the next. Finally, there is no historical evidence that even suggests these features have 19th- or 20th-century origins (Leonard 2003). They simply lie beyond the ken of any European occupant.

Undoubtedly, any of the features present, if evaluated on their individual merits, could be dismissed as happenstance, or the product of some unrelated colonial or latter-day activity. However, the features do coexist and present themselves in remarkable harmonies with their natural surroundings. Once the reader accepts the possibility that he may be looking at a high example of Algonquian landscape architecture, the excitement and possibility of being able to reconstruct even just a bit of lost pre-Contact culture arises. Our initial analyses suggest the Natives maintained a carefully manicured park kept largely cleared, that covered several square miles. Here they gathered, held ceremonies and observed the sky year-round. They kept a calendar, good to the day. They celebrated an annual cycle of seasons and synchronized their moons to it using the same techniques as did contemporary Jews and Chinese, a world away. They were fascinated by the stars at

night and projected the axis of their motion onto their park's floor. There is strong evidence they went out of their way to link all the natural cycles together. They arranged stones on the ground to guide their posterity in their celebrations, and to mark special events. They could communicate the moment of a celestial or ceremonial event occurring anywhere in the park instantly to others by rocking a conveniently nearby perched boulder. Such sophistication may only be an introduction to what may lay hidden here.

Coda

The depth, scope, accuracy and integrity of this re-emerging pre-colonial ceremonial/ritual site suggest an all-encompassing world view that precluded the need for larger man-made edifices. The clearing of the land, the enhancements of the site with easily manipulated, naturally occurring objects suggest an understanding of, and harmony with the natural world entirely consistent with our current and developed understanding of the intelligence, imagination and capacity of the ancients. Life, it seems, in the Taunton River Basin was lush to the point that it required only enhancement to completely connect its inhabitants to the totality of their world. (Danielson 2005)

Appendix

Horizon azimuths of events at the site were determined using its geographic coordinates, spherical trigonometry, its Law of Cosines, and The American Ephemeris and Nautical Almanac (1958). viz.:

$$a = \cos^{-1}\left\{\frac{\cos(90^\circ - \delta) - \cos z \cos(90^\circ - \lambda)}{\sin(90^\circ - \lambda)\sin z}\right\} \quad (1)$$

where: a = desired azimuth
l = latitude of the site
δ = declination of the object
z = zenith distance to the horizon

The variable, z, is critical and requires first determining the true horizon contour of the site. This correction effectively reduces z by the apparent height of any hills, trees or other objects of vertical extent. This was done with the local USGS Quadrangle maps and the author's estimates of probable tree height. The result was a flat horizon elevated about one degree that undulated not more than 15 arc min. Second, a correction must be made for atmospheric refraction. Tables are customarily used. This correction increases z and is substantial. For objects low in the sky, it ranges between 35.4 arc min. and 18.5 arc min. for zero- and two-degree elevations respectively (Allen 1955:120). Accurate z is particularly important for this analysis because at this site's latitude objects rising in the east and setting in the west do so inclined at about 45 degrees to the horizon. Thus, for each degree they are actually above the "true" zero-degree horizon when they appear or disappear, the event is seen one degree further to the south by the observer.

Putative feature alignments were tested using their surveyed Cartesian coordinates (x_i, y_i) in the equations below. The most familiar form of the equation for a straight line is:

$$\mathbf{y = mx + b,}$$

when the slope of the line, m, and its y-intercept, b, are known. However, the less used form:

$$\mathbf{(y - y_0) = m_0(x - x_0)}$$

when a slope, m_0, and a single point, (x_0, y_0), are known, is more useful to us since we are testing primarily associations between astronomical azimuths (slopes) and objects (points) on the ground. Analytic geometry allows us to find where two non-parallel straight lines cross by taking the equations of the two lines:

$$\mathbf{(y - y_1) = m_1(x - x_1)}$$
$$\mathbf{(y - y_2) = m_2(x - x_2)}$$

as simultaneous, and solving them for x and y. Their crossing in our context represents the only observation point from which horizon events, m_1 and m_2, both appear directly over the markers, (x_1, y_1) and

(x_2, y_2).

For our application the most convenient method of solution to employ is matrix algebra. First we rearrange the simultaneous equations to the form:

$$\mathbf{m_1x - y = m_1x_1 - y_1}$$
$$\mathbf{m_2x - y = m_2x_2 - y_2,}$$

which in matrix notation becomes:

$$[x\ y]\begin{bmatrix} m_1 & m_2 \\ -1 & -1 \end{bmatrix} = [m_1x_1 - y_1\ \ m_2x_2 - y_2] \quad (2)$$

whose solution is simply:

$$[x\ y] = [m_1x_1 - y_1\ m_2x_2 - y_2]\begin{bmatrix} m_1 & m_2 \\ -1 & -1 \end{bmatrix}^{-1}$$

However, in our application we have, in some cases, far more than just two postulated sightings from a putative observation point. As soon as the third line is drawn, unless the world is perfect, and it is not, we will have formed a little triangle about the observation point. Additional lines start to make a mess. No longer do we have a perfect spot to observe from. We need to compromise. Mathematically, the best spot to pick is where the sum of the squares of the distances to all the lines is a minimum (the method of Least Squares). This is most easily accomplished for any number of additional observations by using equation (2) above generalized to n observations:

$$[x\ y]\begin{bmatrix} m_1 & m_2 & \cdots & m_n \\ -1 & -1 & \cdots & -1 \end{bmatrix} = [m_1x_1 - y_1\ \ m_2x_2 - y_2\ \ \cdots m_nx_n - y_n]$$

The solution now requires first 'squaring' the matrix of slopes so it can be inverted. This consists of post-multiplying both sides of the equation by the transpose of the slope matrix:

$$[x\ y] = [m_1x_1 - y_1\ \ m_2x_2 - y_2\ \ \cdots m_nx_n - y_n]\begin{bmatrix} m_1 & -1 \\ m_2 & -1 \\ \vdots & \\ m_n & -1 \end{bmatrix} \cdot \left[\begin{bmatrix} m_1 & m_2 & \cdots & m_n \\ -1 & -1 & \cdots & -1 \end{bmatrix}\begin{bmatrix} m_1 & -1 \\ m_2 & -1 \\ \vdots & \\ m_n & -1 \end{bmatrix}\right]^{-1}$$

Once the optimum point, (x, y), is found, and the distances to all lines are determined (the residuals); if we assume that the horizon is flat, the astronomically determined slopes, m_i, will remain constant over the entire area being analyzed. This means that for a real observer standing at the optimum spot, celestial events will appear displaced from their markers by the same amount as the calculated lines miss the optimal observation point.

References Cited

Allen, C. W.
1955 *Astrophysical Quantities*. The Athlone Press, University of London.

The American Ephemeris and Nautical Almanac for the Year 1958
1956 U.S. Government Printing Office, Washington DC.

Aslaksen, Helmer
2002 "When Is Chinese New Year?" *Griffith Observer*, Volume 66, Number 2, February 2002, Griffith Observatory, Los Angeles CA.

Blake, Windsong, Chief of the Wampanoag - Watuppa Band
2003 Personal Communication.

Bragdon, Kathleen
1996 *Native People of Southern New England, 1500-1650.* University of Oklahoma Press, Norman OK.

de Brébeuf, Jean
1898 [1636] *The Jesuit Relations and Allied Documents.....1610-1791*, Volume X, "Hurons 1636", Part 2, The Burrows Bros. Press, Cleveland, OH.

Champlain, Dennis
2003 New England Native American Calendar, May 2003 - April 2004, The Algonquin Indian Arts and Culture Association, Charlestown, RI.

Cook, Roger
1974 *The Tree of Life, Image of the Cosmos*, Avon Books, New York.

Danielson, Arnold
2005 Untitled Note. Personal Communication.

Delano, Emily, informant.
1934 "Cave Where King Philip Once Slept Now Lures East Freetown Children", *New Bedford Sunday Standard*, September 9, 1934, New Bedford, MA.

Ellfeldt, Lois
1967 *A Primer for Choreographers.* National Press Books, Palo Alto CA.

Leonard, Kenneth C., Jr.
1987 "Calendric Keystone (?), The Skidi Pawnee Chart of the Heavens, etc." *Archeoastronomy* Volume 10, The Center for Archeoastronomy, College Park MD.

2003 *The Beechwoods Confederacy, 1709-1809.* Heritage Books Bowie, MD.

Leonard, Luke, Jr,
2005 Personal Communication.

Mavor, J. W., Jr.
2003 Personal Communication.

Mavor, J. W., Jr. and Dix, B.
1989 *Manitou, The Sacred Landscape of New England's Native Civilization*. Inner Traditions International, Rochester VT.

Middleboro Proprietors Records (MPR)
ca 1680 - ca 1720 at Plymouth County Commissioners Office, Plymouth MA.

Minton, Sandra Cerny
1997 *Choreography: A basic Approach Using Improvisation,* Second Edition. Human Kinetics, Champaign IL.

Murie, James R.
1981 [1921] *Ceremonies of the Pawnee. Smithsonian Contributions to Anthropology* Number 27. Smithsonian Institution Press, Washington DC.

Seketau, Ella, Medicine Woman, Narragansett Tribe
2003 Personal Communication.

Simmons, William S.
1986 *Spirit of the New England Tribes*, University Press of New England, Hanover NH.

Sinnott, Roger W.
2001 *Stargazer's Almanacs 2002*. Sky Publishing Corp., Cambridge MA.

2002 *Stargazer's Almanacs 2003.* Sky Publishing Corp., Cambridge MA.

Snow, Dean R.
1980 *The Archaeology of New England.* Academic Press, San Diego CA.

Solomon, Gill, Nanepashmequin (Feather-on-the-Moon), Sachem, Massachusett-Ponkapoag Tribe
2003 Personal Communication.

2004 Notes on an analysis of a Woodland Ceremonial Site. Personal Memorandum.

Spier, Arthur
1996 The Comprehensive Hebrew Calendar, Revised 70-Year Edition, Feldheim Publishers, Nanuet NY.

U. S. Geological Survey Topographic Maps
1963 Assawompset Pond Quadrangle, and Assonet Quadrangle. U. S. Government Printing Office, Washington DC.

U. S. Geological Survey Geologic Maps
Bedrock Topography of theTaunton River Basin, Massachusetts. Map I-742. U. S. Government Printing Office, Washington DC.

Williams, Roger
1973 [1643] *A Key into the Language of America*. Wayne State University Press, Detroit MI.

Wixon, Clint, Chief Lightningfoot, Wampanoag-Herring Pond
2002 Personal Communication.

Integrated Wetland—Dry Land Features with Astronomical Associations

Timothy Fohl

Introduction

This article has several objectives:

- It describes a new class of man-made landscape features that to my knowledge have not previously been identified in New England.
- It suggests that the culture responsible for the features possessed an interest in and a knowledge of astronomy.
- It demonstrates the value of Ground Penetrating Radar (GPR) for studying wetland features.

Chronology of Discovery

These features first came to the author's attention when examining aerial photographs of the land adjacent to Spencer Brook in Carlisle, Massachusetts. This land belongs to the town, and the town was considering construction of subsidized housing units on it. The property has Indian ceremonial features on it and the construction was cause for concern to the Narragansett and Wampanoag Tribes. An informal group consisting of a professional archaeologist, a Deputy Tribal Historic Preservation Officer from the Narragansett Tribe, an avocational archaeologist and the author surveyed the area and prepared a report for the town (Harris et al. 2005). It was in the

course of this study that the aerial photographs of the area were examined. Most of the aerial photographs studied and those presented in this article are from the MassGIS collection (www.mass.gov/mgis), and were taken in 2001.

These photos showed linear features in the wetlands which were probably man-made. Such features are fairly common and are commonly thought to be drainage ditches. As this article shows, these are not all ditches, and some are aligned with certain astronomically interesting directions. It was then realized that some of them were collinear with stone rows and other features on the adjacent dry land. This led to a closer investigation, which could only be done when the wetlands were frozen. It was found that some are low mounds, which were made visible in the aerial photographs by differences in vegetation. Other segments could not be identified on the ground although they are apparent from the air. Others are ditches but do not have any apparent drainage function. To develop more understanding of the mounds, several of them were studied using Ground Penetrating Radar (GPR).

Methods

As noted above, the first recognition of the linear wetland features was through examination of aerial photographs. The photographs were analyzed by the Terrain Navigator Pro software package sold by MyTopo, Billings, Montana. This software allows distance and directions to be determined from topographic maps and downloadable aerial photographs. With one exception, the annotated aerial photographs in this article were created in Terrain Navigator with some post-processing in Adobe Photoshop. The processing involved controlling contrast and adding annotations.

Orientations of certain features by ground measurements were determined with a Brunton sighting compass (precision = $\pm$ 1 degree). Ground measurements of distance were carried out with surveyor's tapes and with a Leica Disto Model A5 precision laser distance meter (precision = $\pm$ 1 cm.). The locations of points on larger scale features were determined with a handheld Garmin GPS unit with a typical accuracy of 2-3 meters. Most of the GPS determined locations were refined by comparison with aerial photographs. The aerial photographs presented in this article are all looking vertically and are oriented with north at the top (with the exception of Figure 17 which is looking northwest on a slant).

Astronomical Concepts

As the title of the article suggests, these features are distinguished by associations with astronomical alignments. Careful inspection of the aerial photographs will reveal that there are linear features visible other than those discussed in this article. They are the subject of another investigation and will not be treated in this article.

Before discussing the details of the features, it seems appropriate to define the astronomical concepts associated with the features. All the features except one are aligned with the azimuths of the sunrise or sunset points on the horizon on significant days. The reciprocal directions of the solstice sunrises and sunsets are also solstice sunsets and sunrises. There are important astronomic events other than those listed here and there are also other constructions which may relate to astronomy. However, this article only considers the following directions:

- The Winter Solstice sunrise (azimuth approximately 123 degrees true)
- The Summer Solstice sunrise (azimuth approximately 58 degrees true)
- The sunrise and sunset on the Equinox days (approximately 90 and 270 degrees)
- The sunset on August 12 (azimuth approximately 290 degrees true)
- The sunrise on August 13 (azimuth approximately 70 degrees true)
- A line parallel to the Milky Way when it is passing through the zenith at the time of the winter solstice (the line is along the 140-320 degree axis.)

The sunrise and sunset directions are accurate to approximately one degree depending on atmospheric conditions and terrain. The sun appears to be ½ de-

gree across. At this latitude the apparent direction of the sun's contact with the horizon will be shifted about one degree for every degree of elevation of the horizon. For very low horizons atmospheric refraction plays a role in the apparent position of the Sun. The Milky Way is much less precisely defined. The winter Milky Way appears to be between 15 and 30 degrees wide depending on how ambient lighting conditions affect perceptions. The directions in this article refer to the center line which has an uncertainty of approximately 5 degrees but is not dependent on horizon elevation.

The solstice and equinox alignments are well known and are important to cultures across most of North America (Aveni 2001, Williamson 1984). An example is the Nikkomo Celebration held in New England by the Narragansett and Nipmuc Tribes around the Winter Solstice. The other directions may require some elaboration. The sunset and sunrise around August 12 and also on May 1 are widely marked by alignments in Mesoamerica (Aveni 2001, Malmstrom 1996). The entire city of Teotihuacan, the greatest Mesoamerican ceremonial center, is aligned to the sunset at that time. The dates August 12 and May 1 are 260 days apart and are intimately involved in the 260-day calendar used by Mesoamericans for thousands of years and still in use in certain areas (Tedlock 1982). It is less well known that these are important dates north of Mesoamerica as well. An early 19th Century star chart in the Field Museum in Chicago is attributed to the Skidi Pawnee. It has been interpreted as showing the sky on the night of August 12-13 (Leonard 1987, Chamberlain 1982, Murie 1981). Important ceremonies are held near these dates by modern tribes in the Northeast and are part of an ancient tradition (www.narragansett-tribe.org). There are numerous structures aligned with both the sunrise and sunset on these days in New England (Fohl and Leonard 2006). It should be noted that areas in the vicinity of the wetlands discussed in this article have astronomically aligned features also (Harris et al. 2005).

The directions of the Milky Way when it passes directly overhead form a cross which divides the sky into quadrants (not simultaneously but at two times of the year: winter and summer) according to South American beliefs (Sullivan 1996). In the winter, around the Winter Solstice, the line runs roughly 140-320 degrees. In the summer, around the middle of August, the line runs roughly 40-220 degrees. The Milky Way has been widely thought of as the pathway of souls by Indians all over the Americas (Lankford 2007). There are numerous features aligned with these directions in New England. An example is the Wampanoag Royal Cemetery in Lakeville, MA, whose boundaries are aligned with these two lines (Leonard 2007).

Overview of the Study Area

The wetland considered in this article surrounds Spencer Brook, a tributary of the Assabet River, on the border between the towns of Concord and Carlisle in eastern Massachusetts (Figure 1). Although not formally named, it is referred to as Spencer Brook Swamp in this article. In colonial times it was called Fifty Acre Meadow (Lapham 1970, Donahue 2004, Shattuck 1835). It lies between South and West Streets in Carlisle to the west and a housing development on an esker to the east. There are four groups of wetland features outlined with white lines and designated as Features A, B, C, and D in Figure 1.

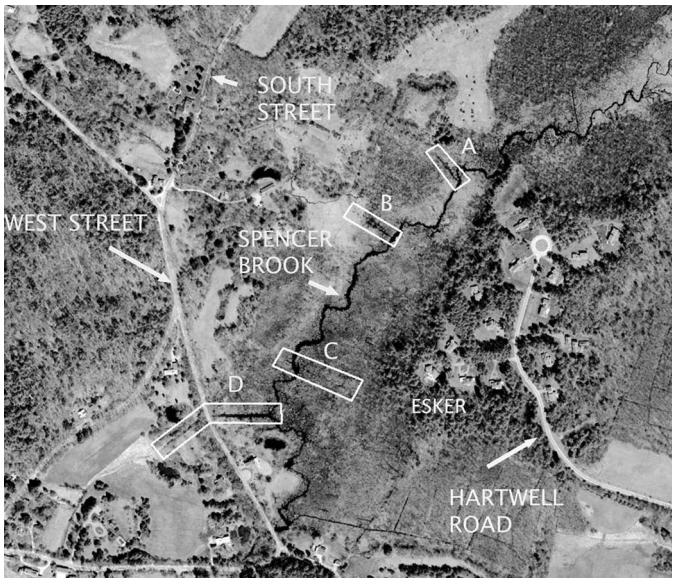


Figure 1. Aerial Photograph of the Study Area in the Spencer Brook Swamp. (Photograph from MassGIS via Terrain Navigator and annotated by T. Fohl)

The dry land features are shown as solid white lines in Figure 2. Lines in wetlands and between widely separated features on dry land are shown as dashed lines. Individual separated stones are indicated by white square dots. The dry land features are designated by numbers 1-7. These groups of features will be discussed in detail in the following sections.

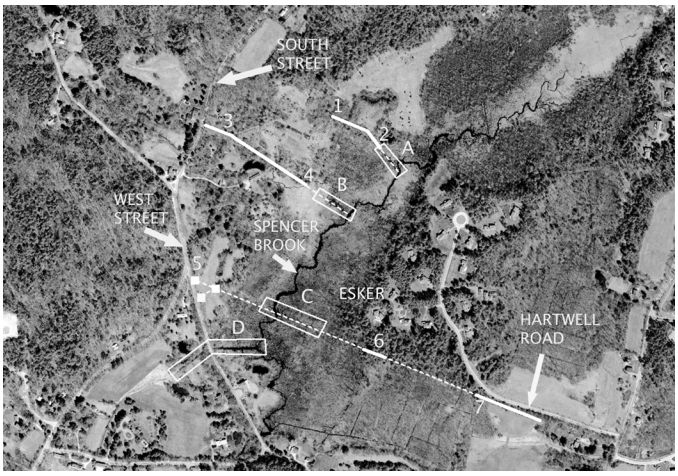


Figure 2. Overview of Study Area with Features on Dry Land Shown as Solid White Lines and Square Dots. (Photograph from MassGIS via Terrain Navigator and annotated by T. Fohl)

Wetland Features A and B

Details of the two northernmost wetland features, designated as A and B, are shown in Figure 3. The linear features are visible in the aerial photographs because of variations in vegetation on top of them. These variations are probably caused by the disturbance of the wetlands when the features were built. They appear to be lines of low mounds of earth with signs of ditching on either side. When covered by snow, the mounds of Feature B are seen to be about 30 centimeters high (Figure 4). The snow in the figure is of fairly uniform depth (approximately 15 centimeters) and it is assumed that the shape of the snow covered surface is similar to the shape of the surface of the snow.

Wetland Feature A

Wetland Feature A is more or less continuous from Spencer Brook to near the edge of the wetland where it meets a collinear stone row that extends onto dry land (Figure 5), a distance of 79 meters. The row

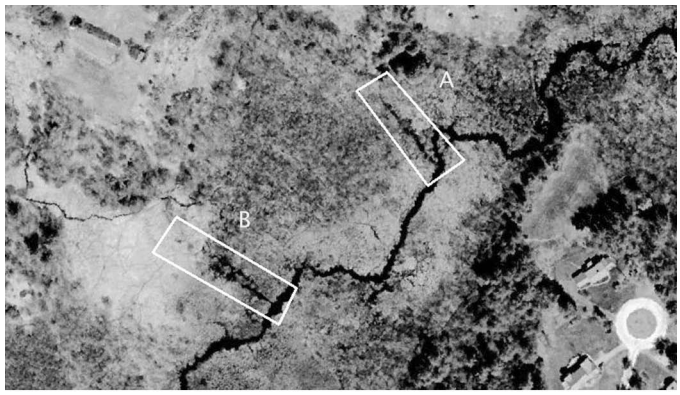


Figure 3. Detailed Aerial Photograph of Features A and B. (Photograph from MassGIS via Terrain Navigator and modified by T. Fohl)

Figure 4. Section of the Row of Mounds Forming Feature B. Arrows designate tops of mounds. (photograph by T. Fohl)

Figure 5. Stone Row (Dry Land Feature 2) Ending in the Wetland and Connecting to Wetland Feature A. (photograph by T. Fohl)

of mounds and the stone row are aligned with the winter Milky Way (140-320 degrees). The stone row continues in this direction for 35 meters to the top of a small knoll. At the top of the knoll the row meets another row that aligns with the August 12 sunset. This row continues for approximately 84 meters to a small wet area where it thins out and stops. The locations of these rows can be seen as solid lines in Figure 2 and are labeled as dry land Features 1 and 2, with Feature 2 being the stone row touching the Spencer Brook wetland.

Wetland Feature B

Wetland Feature B is apparently not continuous from Spencer Brook to the edge of the wetlands. It is a row of mounds which runs about 70 meters from Spencer Brook toward the edge of the wetlands leaving a clear distance between the mounds and the edge of the wetland of about 53 meters. It is, however, collinear with a stone row that ends in the wetland (Figure 6). This stone row (Dry Land Feature 4) runs along the edge of the wetland, through a stream and along a peninsula between two wet areas for 195 meters. This section of the stone row and the row of mounds in the wetland are aligned with the Winter Solstice sunrise (approximately 123 degrees). As can be seen in Figure 2, the row connects with another row (dry land Feature 3) that runs to the edge of South Street. This row is aligned with the August 12 sunset (approximately 290 degrees). It is 71 meters long.

Figure 6. End of Stone Row (Dry Land Feature 4) in Wetland. It is collinear with Wetland Feature B. (photograph by T. Fohl)

Wetland Features C and D

There are two wetland features found in the southern section of Spencer Brook Swamp. They are labeled C and D in Figures 1, 2 and 7.

Wetland Feature C

The first of two wetland features found in the southern section of Spencer Brook Swamp is labeled Feature C in Figures 1 and 2. Feature C is part of a rather

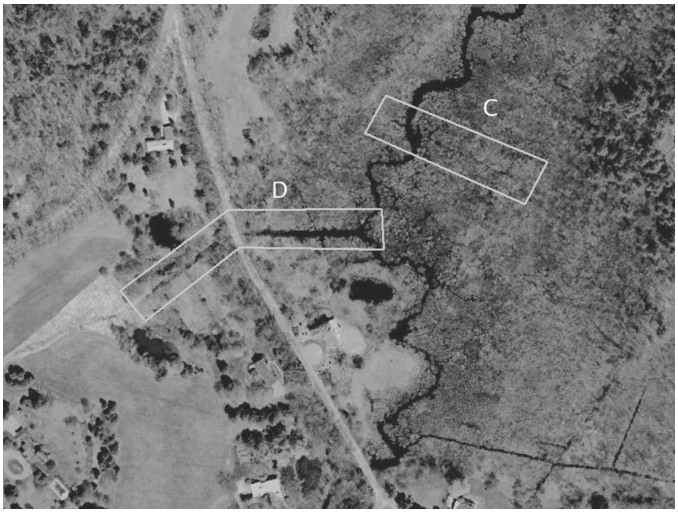


Figure 7. Detail View of Aerial Photograph Showing Linear Features C and D. (Photograph from MassGIS via Terrain Navigator and annotated by T. Fohl)

complex set of features arrayed along a line that points toward the August 12 sunset. The following components of this line are listed below, starting at the eastern end of the line:

- stone row ending in a two-rock pile: Dry Land Feature 7 in Figure 2 (length: 168 meters)
- earthen mound (length: 20 meters)
- ditch (length: 20 meters)
- stone row including horseshoe shaped array of stones: Dry Land Feature 6 in Figure 2 (length: 25 meters)
- ditch (length: 15 meters)
- Wetland Feature C itself (length: 130 meters),
- triangular array of large rocks: Dry Land Feature 5 in Figure 2

With the exception of the triangular array of rocks, these components of the line are obviously man-made.

Beginning at the southeastern end and following the line northwest toward the sunset, the line is defined by a stone row 168 meters long running nearly parallel to Hartwell Road in Concord, MA. It ends near the the edge of the wetland (Figure 8). This feature is designated as Dry Land Feature 7 in Figure 2 and is shown as a solid white line.

Starting approximately 3 meters from the end of the stone row (Figure 8), a low earthen mound continues

Figure 8. End of the Stone Row (Dry Land Feature 7), Adjacent to Hartwell Road. (photograph by T. Fohl)

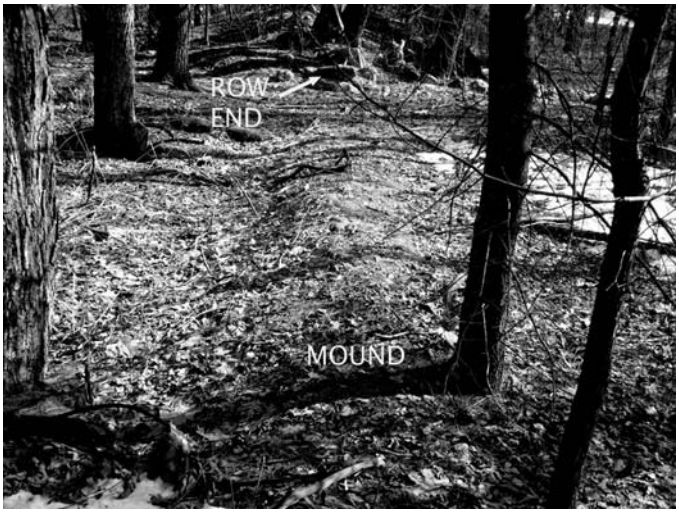


Figure 9. Earthen Mound that Extends the Line into the Wetland. View is looking southeast toward the end of the stone row adjacent to Hartwell Road. (photograph by T. Fohl)

on the line for approximately 20 meters into the wetland (Figure 9).

The earthen mound connects to a ditch which is approximately on the line but is also part of a network of ditches (Figure 10). The channel formed by the ditch touches the mound from the right and runs parallel to it for about 15 meters. At the end of the mound the channel widens and continues along the line.

Continuing along the line to the northwest, the ditch ends after approximately 20 meters and there are no apparent features on the line in the wetland for approximately 190 meters. At this point the line contacts the southern end of the esker shown in Figures 1 and 2. A row of stones starts at the water's edge and crosses the esker to the water on the other side, a distance of approximately 25 meters. The row is shown as a solid white line in Figure 2 and is designated as Dry Land Feature 6.

At the approximate midpoint of the row of stones that crosses the esker, there is a loose, horseshoe-shaped array of stones which is bisected by the row (Figure 11). The horseshoe opens to the northwest facing the August 12 sunset. In the photograph, Figure 11, the stones do not stand out well from the surrounding forest debris, and so are designated by white arrows.

The stone row going northwest ends at the water's edge (Figure 12).

There is a ditch continuing the line in the wetland to the northwest beginning where the stone row ends. It disappears in the wetland growth after approximately 15 meters.

It is worth noting that this part of the esker at least is otherwise completely free of stones. This suggests that the stones forming the row and the horseshoe array were transported from a considerable distance away. A walking survey of this section of the esker found no stones on the surface within at least 100 meters. Most of the esker is now in private yards which were inaccessible and it is possible that there were stones in these areas. Some of the stones are estimated to weigh

hundreds of kilograms and would require a lot of effort to move.

Starting at the end of the ditch which runs northwest from the esker, there are no visible features until the line meets the linear wetland Feature C, a distance of approximately 110 meters (Figures 2 and 7). Feature C extends to the bank of Spencer Brook. A feature on the other side of the brook is in line with it and is included as part of Wetland Feature C. Feature C is roughly 130 meters long.

The line extending from Wetland Feature C has no visible features as it crosses the wetland to the northwest from Spencer Brook until it reaches a very large rock on dry land near the edge of the wetland (Figure 13). This rock is part of a triangular array of very large rocks indicated by the square white dots in Figure 2 in the vicinity of West Street in Carlisle. This array is designated as Dry Land Feature 5. The line connects the rock near the wetland and the northern rock of the triangle while passing over another large rock in the open field (not marked in Figure 2 but noted in Figure 16). The final rock in this line is about one meter high and two meters across (Figure 14). It has an array of smaller stones distributed over its top surface. A line connecting the third, southern rock (Figure 15) and the first rock near the wetland is aligned with the sunrise on August 13. A schematic diagram of the triangular array and these relationships is shown in Figure 16. The triangular array is at the southern edge of group of approximately ten ceremonial structures covering an area of approximately 2,000 square meters adjacent to West Street.

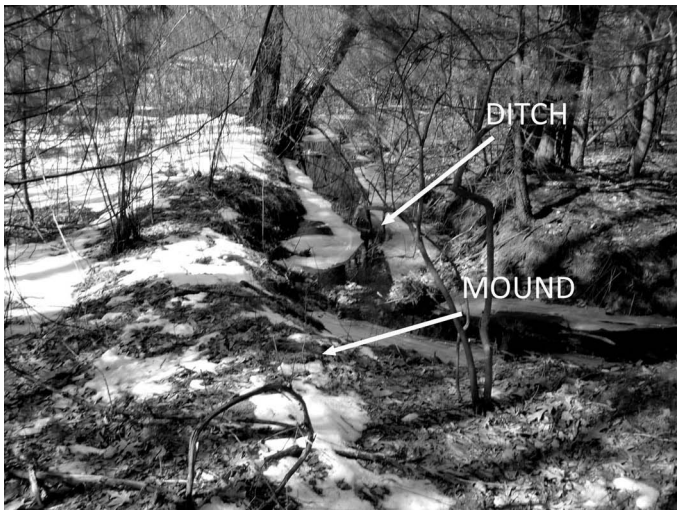


Figure 10. Earthen Mound Connecting to the Ditch Looking Northwest. (photograph by T. Fohl)

Figure 11. Horseshoe shaped Array of Stones Designated by White Arrows. Distance between foreground rocks is approximately 0.75 meters. (photograph by T. Fohl)

Wetland Feature D

Wetland Feature D consists of a pair of ditches which converge at an angle of 168 degrees. They are shown in the aerial photograph of Figure 7 and in a closer view in a photograph downloaded from Bing Maps (Figure 17) (www.bing.com/maps/). The western branch, labeled Channel 1, is aligned with the sunrise on the Summer Solstice and with the sunset on the Winter Solstice: at azimuths of 58 and 238 degrees, respectively. Channel 2 is oriented along an east-west line and is aligned with the sunrise and sunset at the Equinoxes.

The channels would drain water from the spring area to the west of Channel 1 into Spencer Brook through Channel 2 if they were connected. However, there is no direct connection between the two channels at present. The roadway which divides them may have been built after the channels were dug. A road was built from Concord to Fifty Acre Meadow, which was the old name for Spencer Brook Swamp, in 1666. It was extended to the north soon thereafter and was called the Groton Road. It is now called West Street. A road was built from Groton Road to connect with a road to Chelmsford before

Figure 12. Section of Stone Row (Dry Land Feature 6) Crossing the Esker and Contacting the Water Looking Northwest. (photograph by T. Fohl)

1671. It is now South Street. Simon Davis Jr. built a house on the corner of South and West Streets in 1685 (Lapham 1970). While it isn't certain where the Groton Road crossed the wetland it seems plausible that the connection between the two ditches was blocked by 1670.

Ground Penetrating Radar (GPR) Studies

GPR was used to obtain information about the interior structure of wetland Features A and B and their surroundings without disturbing the wetland. GPR works by sending an electromagnetic pulse into the ground and recording its reflection from discontinuities in the ground underneath. The antenna unit of the GPR system has two antennas. One sends the pulse down into the ground and the other detects the reflected pulse. The detected pulse is recorded and analyzed in the data logger part of the GPR system.

GPR is widely used in construction work and more recently in archaeology. For a complete treatment of the use of GPR in archaeology see Conyers (2004). The scans reported in this article were carried out by Steven Arcone of the U. S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH. He has extensive experience using GPR in Antarctica and in frozen wetlands in New England.

The GPR scans were done with a SIR 3000 data logger using a 400 megahertz antenna manufactured by GSSI, Salem, NH. The scans were taken by flagging 50 foot long paths that crossed the linear features, roughly perpendicular to their axes. The traverses were made at selected sections of the mounds and the data shown represent the results of single traverses over separate mounds. The radar antenna was mounted on a sled and dragged across the snow-covered mounds. One person dragged the sled and the GPR operator followed while monitoring the data logger. A photograph of the antenna on the sled is shown in Figure 18. Distances were determined by manually inserting tick marks in the recorded traces as the end flags were passed. A constant drag speed was assumed.

Figure 13. Rock on Dry Land near Wetland in Line with Wetland Feature C. Rock is approximately 2.5 meters long. (photograph by T. Fohl)

Figure 14. The Final Rock in the Line of Features Connected with Linear Wetland Feature C. Note smaller rocks distributed on top. (photograph by T. Fohl)

Figure 15. Third Rock of Triangular Array. It is approximately 1.5 meters high. (photograph by T. Fohl)

Selected portions of the traces obtained from traverses over the mounds of wetland Features A and B are shown in Figures 19 and 20.

Figures 19 and 20 show relatively unprocessed data from GPR traces across selected parts of wetland Features A and B. The data logger applies proprietary corrections for such factors as attenuation of the signal and effects at the ground surface. The data of Figure 19 and 20 are not processed further.

The wavy bands of light and dark areas indicate the varying strength of reflected pulses of electromagnetic energy from strata in the material beneath the antenna. As the antenna is moved along the surface, the traces are extended in time to the right. Assuming the antenna is moved at a constant speed, distance along the horizontal traverse line is proportional to distance along the horizontal time axis. The vertical axis is a time axis as well. Assuming a constant vertical propagation velocity for the electromagnetic energy, distance along the vertical time axis is proportional to depth. Thus the images are maps of subsurface structure as a function of depth and distance along the line of the traverse. In these examples, a typical propagation velocity for wetland material was used to set the vertical depth scale and it is shown in meters. The nominal velocity setting was 7.5 centimeters per nanosecond, which was chosen on the basis of standard tabulated values. The horizontal scale was set by using manually set tick marks as described above.

Both data sets show relatively even bands of alternately black and white lines on either side and over the center of the mounds near the surface (approximately 0 - 50 centimeters deep). These probably indicate that these strata were laid down smoothly over a stable structure. The bands bow downward alongside the mounds and bow upward at the center of the mounds. The actual upward bowing is more pronounced than the traces indicate because the surface over the mound bulges upward and the traces are not corrected for this effect. The shapes of the strata suggest that material was dug from the area beside the mounds (indicated as ditches in the figures) and piled up to form the mounds. After the mounds were built, some processes probably deposited material over them and the ditches beside them to form the smooth strata. Also note that the deeper strata under the continuous bands are more disorderly, which may be an indication of the disturbance caused by earth moving.

More research using GPR and possibly coring techniques should be done before any conclusive statements about these wetland features are made. However, it is possible to make some observations about the probable history of the mounds. The continuous undisturbed character of the strata near the surface

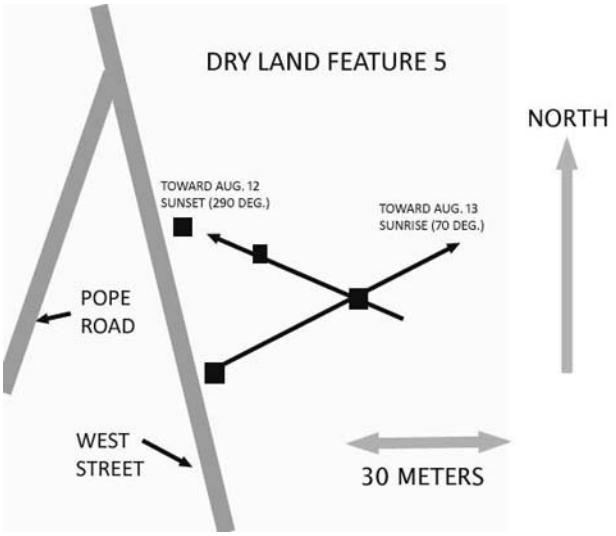


Figure 16. Schematic of Triangular Dry Land Feature 5. (Drawing by T. Fohl)

(less than ~ 0.5 meter) show that these strata were deposited under relatively gentle conditions. The fact that they overlay more disturbed strata and are continuous over the dug out areas and the mounded up areas indicates that they were deposited after the mounds were built.

Another GPR scan was obtained almost by accident while leaving the wetland. It is not shown here because neither the exact location nor the horizontal distance were recorded. It detected what is most likely a succession of pond bottoms that slope upward to the present shoreline. These show successive episodes of filling in of the pond until it finally

Figure 17. A Bing Maps Bird's Eye View of the channels that Form Wetland Feature D (annotated by T. Fohl)

Figure 18. Ground Penetrating Radar 400 megahertz antenna on sled. (photograph by T. Fohl)

became a wetland. The deepest bottom seemed to be more than 3 meters below the present surface near the center of the pond. Although we did not get this data in the immediate vicinity of the mounds, it probably was originally quite deep near their location at one time. It would be difficult to raise the mounds if their surroundings were in deep water. This suggests that the date of construction was after the pond had filled in to the point where it was shallow enough for digging, but before the upper strata were deposited.

This hypothesis suggests that methods such as pollen analysis done in strata somewhat removed from the mounds could provide dates for the construction of the mounds without disturbing the mounds themselves. Geological analysis of the filling in episodes could also yield chronological information. Once this is established, it would be plausible to estimate dates for the stone features by association with the wetland features with which they are collinear.

Discussion and Conclusions

The evidence presented in this article makes a strong case for the human construction of the linear features in the Spencer Brook Swamp. It also makes a case for the wetland structures being conceptually connected to the dry land stone structures, even if they were not built by the same group of individuals. The

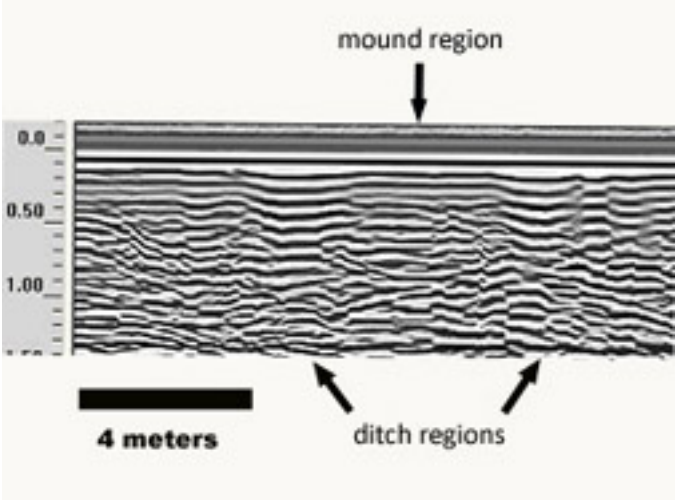


Figure 19. Ground Penetrating Radar (GPR) Trace on Wetland Feature A (Courtesy S. Arcone; modified by T. Fohl)

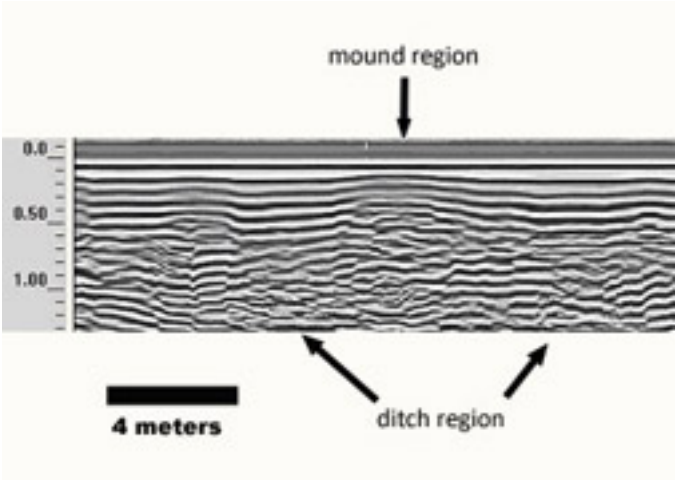


Figure 20. Ground Penetrating Radar (GPR) Trace on Wetland Feature B (Courtesy S. Arcone; modified by T. Fohl)

fact that these structures have strong astronomical associations implies that astronomical concepts were at least part of the motivation for their construction.

Although the dry land structures resemble familiar New England stone fences in some instances, they differ in numerous details. Some differences are the following:

- Astronomical orientations are not thought to have been a factor in construction of farm walls.
- The connection with wetland structures does not follow farm practice.
- Many of the structures do not serve any farm-related purpose. They do not enclose anything, nor are they repositories of locally excavated stones.
- Parts of these structures simply are not walls. They are rows of loosely spaced stones.
- The apparent connections between widely separated features argue for a large scale design that doesn't seem to have an agricultural function.

The wetland structures are also difficult to connect to an agricultural function. Conceivably the mounds could have been supports for catwalks to the stream. But simpler access points are abundant. An example is the area where the road crosses the brook as shown in Figures 1 and 2. Such functions are also not consistent with alignments to stone structures on land and to astronomically important directions.

None of these factors tells us who built these structures or when. It is a fascinating puzzle. Regardless of who built these features, they do, in fact, exist as part of the built environment. Since the answers to the questions of by whom, when and why they were built are not known, this is a valid archaeological question which has received little or no previous attention. Moreover, the wetland structures offer a tantalizing possibility for dating both the wetland structures and the dry land structures non-destructively by dating pollen from the relatively undisturbed strata adjacent to the mounds.

Although the observations in this article may suggest that Indian cultures were responsible for these features, there is no direct evidence as to who actually did build them. While I have discussed these features with tribal members, there has been no input from them on the subject. The observations and conclusions are all based on work done over the past three years by the author and his collaborator, Steven Arcone.

Acknowledgements

The author extends thanks to Steven Arcone who suffered in the wintry swamps and obtained fascinating GPR data. Thanks to Kenneth Leonard and

William Sullivan for reading the draft and making useful suggestions. Extra thanks to Curtiss Hoffman whose numerous comments and suggestions have greatly improved this article.

References Cited

Aveni, Anthony F.
2001 *Skywatchers*. University of Texas Press, Austin TX.

Bing Maps
n.d. www.bing.com/maps, Microsoft Corp , Seattle WA.

Chamberlain, Von Del
1982 *When Stars Came down to Earth: Cosmology of the Skidi Pawnee Indians of North America.* Ballena Press, Los Altos CA.

Conyers, Lawrence B.
2004 *Ground-Penetrating Radar for Archaeology.* Altamira Press, Walnut Creek CA.

Donahue, Brian
2004 *The Great Meadow*. Yale University Press, New Haven CT.

Fohl, Timothy and Kenneth Leonard
2006 Similarities of Ceremonial Structures in New England and Mesoamerica. Paper presented at the 73rd Annual Meeting of the Eastern States Archaeological Federation jointly with the Massachusetts Archaeological Society and The New England Antiquities Research Association, Fitchburg MA.

Harris, Doug, Curtiss Hoffman, Peter Waksman and Timothy Fohl
2005 Survey Report of Indian Ceremonial Structures on Benfield Parcel "A" in Carlisle, Massachusetts. Available at the Gleason Public Library, Carlisle MA.

Lankford, George E.
2007 *Reachable Stars: Patterns in the Ethnoastronomy of Eastern North America*. University of Alabama Press, Tuscaloosa AL.

Lapham, Donald A.
1970 *Carlisle, Composite Community*. Privately printed, available at the Gleason Public Library, Carlisle MA.

Leonard, Kenneth
1987 Calendric Keystone? The Skidi Pawnee Chart of the Heavens, etc. *Archaeoastronomy* 10:76 - 87.

2007 Personal communication.

Malmstrom, Vincent H.
1996 *Cycles of the Sun, Mysteries of the Moon*. University of Texas Press, Austin, TX. Available online at http://www.dartmouth.edu/~izapa/.

MassGIS
2001 Aerial photographs available online at www.mass.gov/mgis.

Murie, James R. (ed. Douglas R. Parks)
1981 *Ceremonies of the Pawnee.* Smithsonian Institution Press, Washington DC.

Shattuck, Lemuel
1835 *A History of the Town of Concord; Middlesex County, Massachusetts, and of the Adjoining Towns, Bedford, Acton, Lincoln and Carlisle*. Russell, Odiorne and Company, Boston MA.

Sullivan, William
1996 *The Secret of the Incas: Myth, Astronomy and the War Against Time.* Three Rivers Press, New York.

Tedlock, Barbara
1982 *Time and the Highland Maya.* University of New Mexico Press, Albuquerque NM.

Williamson, Ray A.
1984 *Living the Sky: The Cosmos of the American Indian*. University of Oklahoma Press, Norman OK.

CONTRIBUTORS

Edmund (Ted) Ballard is an Engineering graduate of Brown University and has an M.B.A. from Boston University. He is a retired Senior Member of the Technical Staff of Texas Instruments Inc., a former Treasurer and currently Trustee of the Massachusetts Archaeological Society, the former Chair of the Research Committee of the New England Antiquities Research Association, and a Trustee of the Carpenter Museum in Rehoboth, MA.

Timothy Fohl is a geophysicist educated at Dartmouth College (AB) and M.I.T. (M.S., Ph.D.). He is President of the Technology Integration Group, Inc. He has published in a variety of scientific and engineering fields. In recent years he has worked with Indian Tribal Historic Preservation Offices to provide technical support for their efforts to preserve ceremonial sites. Currently he is a Trustee of the Massachusetts Archaeological Society.

Kenneth C. Leonard, Jr. is a resident of Lakeville and a 1960 graduate of Harvard College in Astronomy, recently retired from a 30-year career at Westinghouse Electric Corp., where he held a variety of positions in engineering and management. He has authored numerous technical papers, including one in *Archaeoastronomy* on the calendric technique of the Pawnees. In 2003, Heritage Books published his colonial history of southeastern Massachusetts, *The Beechwoods Confederacy.* He is presently continuing to research the pre-colonial cultures of this region.

James Mavor, Jr. was a member of numerous professional societies and organizations, including the Marine Technology Society, Society of Naval Architects and Marine Engineers, and the American Association for the Advancement of Science. He was a consultant in engineering design and analysis, education and yacht design, and authored or co-authored more than 25 publications and 35 technical reports as well as the 1969 book *Voyage to Atlantis* during his career at the Woods Hole Oceanographic Institute. In 1989, with Byron Dix, he published an important monograph on the subject of New England stonework, *Manitou: The Sacred Landscape of New England's Native Civilization*. He passed away in 2006.

.

NOTES TO CONTRIBUTORS

The Editor solicits for publication original contributions related to the archaeology of Massachusetts. Authors of articles submitted to the *Bulletin of the Massachusetts Archaeological Society* are requested to follow the style guide for *American Antiquity* (48:429-442 [1983]). Manuscripts should be sent to the Editor for evaluation and comment at c1hoffman@bridgew.edu.

For shorter manuscripts (5 pages or less), texts may be submitted as paper copies. Longer manuscripts should be submitted as electronic files (preferably MicroSoft Word .doc or .docx files, or .rtf files). All text should have margins of 3 centimeters (1¼ inch) on all edges. For electronic files, do not insert artificial spaces between lines; instead, use the Format/Paragraph/Line Spacing function and select "Double". Proper heading and bibliographic material must be included.

Bibliographic references should be listed alphabetically by author's last name and presented as follows:

Gookin, Daniel
1970 Historical Collections of the Indians of New England (1674). Jeffrey H. Fiske, annotator. Towtaid, Worcester MA.

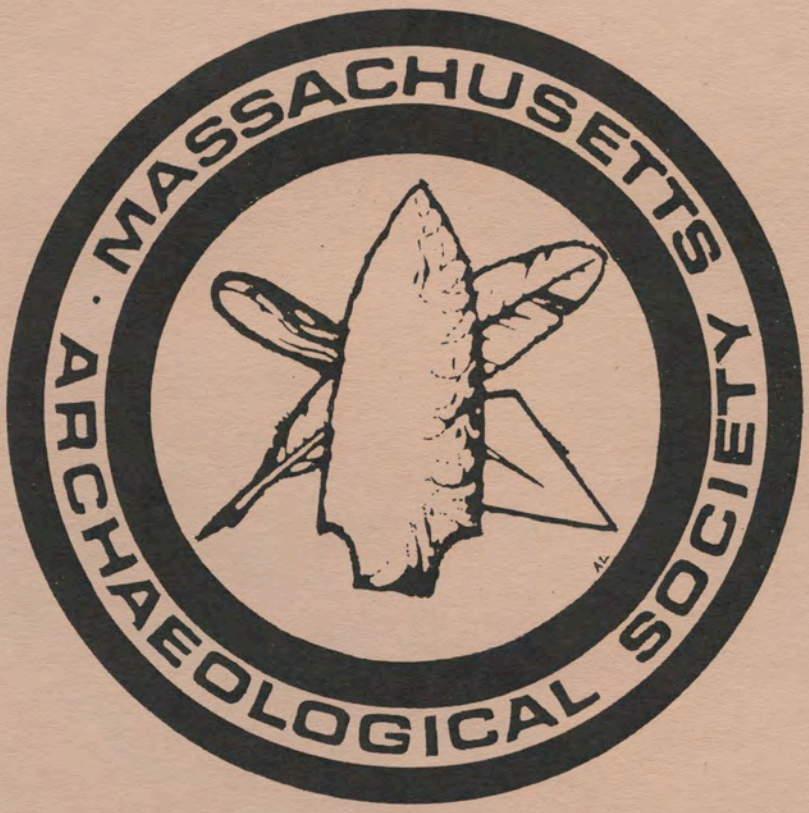
Several references by the same author should be listed chronologically by year. Reference citations in the text should include the author's name, date of publication, and the page or figure number, all enclosed in parentheses, as follows: (Bowman and Zeoli 1973:27) or (Ritchie 1965: Fig. 12). All information derived from published sources must be cited, whether it is directly quoted or paraphrased. Please check to make sure that citations in the text match bibliographical entries, especially dates of publication.

All illustrations and tables, called figures, should be submitted as electronic originals. Tables should be submitted as separate Excel (.xls or .xlsx) spreadsheets and not incorporated into the text. Figures should be submitted as either .tif or .jpg files, high contrast, in greyscale. Each figure should fit within the space available on a Bulletin page, which is 17 cm by 23 cm (6½ x 9 inches), allowing for margins. Full, half or quarter page figures should be planned carefully. Space must be allowed for captions. Captions should be in title case and should accompany the text in a separate section, in order and numbered to correspond to the figures.

Figures must be referred to in the text and are to be numbered in their order of reference, with their number indicated in the file name. Every item in each figure and each person should be identified. All lettering must be clear and legible. Scales with dimensions, preferably in metric measurements, should be included with all figures for which they are appropriate.

Dimensions and distances should be given in metric units or in metric units and English units, to the same standard of accuracy (e.g., 10 cm or 2.5 inches, not 2.54 inches).

Authors should include a brief (1 paragraph) biography for the "Contributors" page of the *Bulletin* issue.



ISSN 0148 1886